RAILROAD GAZETTE

WATCHMEN OR AUTOMATIC BELLS?

The grade crossing accident at St. Louis, September 3, in which six persons were killed, was followed by an animated discussion, in the newspapers, and it came out that the railroad company had asked special permission from the proper bureau of the city government to allow certain crossings to be watched by men without putting up gates. The city had demanded that gates be erected without delay and the railroad company begged off on the ground that that was not the best way to promote the safety of people crossing the tracks. It turned out that Sarah street, where the collision occurred, was not one of those concerning which this arrangement was made, although at first it was so claimed. This, however, has nothing to do with our present purpose. Neither shall we take up at this time the question of the protection of electric cars, as distinguished from the protection of horses, carriages and pedestrians; the only adequate protection at grade crossings for the heavy and fast cars which nowadays are run on electric railroads is to put them on precisely the same basis as the cars and engines of the steam railroad; that is, to require a complete equipment of interlocked signals for both lines, the same as in the case of a crossing of one steam railroad with another. The point we wish to make now may best be introduced by quoting a letter published in a St. Louis paper, sent by an officer of the Wabash to the commissioner of the street department of the city four months ago. In this letter it is said:

"In regard to the crossings at Newstead, Boyle and Delmar avenues, at which this company has agreed to place gates provided it is necessary for the protection of teams and pedestrians, I find from long experience with gates in this city, Chicago, Detroit, Buffalo and Cleveland, that they are of very little practical use so far as perfect protection is concerned. When there are gates at a crossing the man who attends the gates stays in his house and looks out for trains; as soon as he sees one approaching he turns his back to the crossing to pump his gates down, and from that moment until the time the train passes he is of no value as a crossing watchman. From the time the gateman begins to pump his gates until they are down is about two minutes, if they are in order. During these two minutes there is absolutely nothing to prevent a team from driving on the track, or a pedestrian from walking on it; as a matter of fact, over half our claims from Chicago arise from cases where the driver or the pedestrian have passed under the gates while they were being lowered, in the hopes to beat the train.

"It is my opinion that a good watchman who stands on the crossing at all times and continually keeps his eyes on the tracks and upon the teams can do much more towards making a railroad crossing practically safe than crossing gates ever can.

"If you are willing to allow us to operate these crossings without gates I will place a good, reliable day and night crossing man at each street named, and keep them there. And, while I cannot guarantee that no accidents will happen at any of these crossings, I can say that the service will be much nearer perfect than gates could make it."

We print these views of the Wabash officer because they have a considerable basis of reason. (Though his own statement of reasons is defective.) Crossings are guarded in three ways; by gates, with an attendant; by men, without gates, waving a flag, and by automatic bells without either gates or men. The common view is that the three are effective in proportion to their cost, the bells being the cheapest and the least reliable. But this is by no means to be unreservedly accepted as everywhere true. Bells may give many a useful warning that is never put on record, making the cheapest method the best. Our gates are not perfectly effective barriers, because they are so easily broken and because pedestrians can crawl under them; so that the costliest method may not give the protection that it seems to give.

The gate being only an imitation or a partial barrier, why is not an efficient man with a flag about equally good? It may be that to carry our point we should have to amplify our flag into a "big stick," for if the man be disposed to be "efficient" he will often find it necessary to club foolhardy people into submission to his commands, or at least to threaten to do so. But whether with a stick, or a commanding voice, or a frowning countenance, a man of the right kind certainly can give a fully adequate warning to any person not blind or deaf. The real difficulty is in finding the right man. Those who can subdue reckless drivers by a look, and who will be vigilant to protect every absent-minded pedestriar, are not to be had for a dollar and a quarter a day. But that is half the trouble with the gates. The vigilant man is needed with the gate. With attendants of feeble body or mind, or even with men of considerable energy, if they are not carefully disciplined, there must always be occasional lapses, gates or no gates. Given the necessary ability on the part of the attendant, the gate is not necessarily a hindrance, for the apparatus need not be arranged (as described by the Wabash man) to require the attendant to turn his back to the crossing. On the whole, therefore, it may be said that there is potentially much sense in the theory that a man is as good without a gate as with one; though practically, with a large share of the crossings everywhere manned by more or less dull or unskilful or superannuated men, the theory is not proved.

But there is a prominent officer of a large Western road who holds that a bell is better than either a man with a flag or man and gates together. This opinion is based on long experience and extensive study of the records of the claim department; and while not susceptible of demonstration is worthy of respect, because of its source and because an automatic apparatus ought to do away with most of the troubles due to human fallibility. Bells properly cared for are now free from most of the deficiencies that gave them such a doubtful reputation a few years ago. Unfortunately, it is probably too much to assume, even now, that every municipal government could be safely assured that if it got all its crossings equipped with bells it would be securing the protection that it bargained for. Poorly managed signal departments, and poorly managed roads that have no signal department, are not yet quite extinct, and bells neglected by the inspector are no more reliable now than in the past. But competent batterymen, repairmen and inspectors are not so rare as formerly, apparatus has been more fully perfected and bells can be made to do what they purport to do; so that the theory that a bell "fills the bill" deserves careful consideration. A bell should not be required to do more than it is designed to do. It should not be expected to give satisfactory service in and near yards, where there is much backing-up and many low-speed movements. A bell should receive as careful inspection and maintenance as an automatic block signal. But with all the conditions intelligently considered, there would seem to be no reason why the obvious advantages of the automatic bell should not be availed of. The cost is far less than for an attendant, and it is on duty 168 hours a week; and it affords a practicable means for forestalling the demands which municipal officers feel it their duty to make on the railroads every few months or years. It is perhaps hopeless to think of smothering city or town officials by kindness; of safeguarding crossings before they think to ask for a gateman; but the idea is worth thinking about.

CRANES IN ENGINE HOUSES.

The weakest point in the organization and equipment of the motive power department on most railroads is the lack of adequate roundhouse and engine terminal facilities. While so much attention has been paid to building modern and well equipped general repair shops for making the heavy repairs to locomotives, the equipment and organization of the smaller shops and roundhouses at outlying points has been sadly neglected. It is true that there have been decided improvements in the general design of engine houses in the way of better lighting, heating and ventilation, and all of these have had their effect in making work easier and in reducing the cost of running repairs to some extent, but there is still much to be desired. On most railroads the running repairs and light repairs which are made on the road and in the engine houses amount to considerably more than half of the total cost of locomotive repairs, both light and heavy, and proportionately there is usually more need for improvement in the facilities of the small shops than there was for improvement of the main shops, because the conditions were worse to start with. It is not sufficient to simply provide plenty of light and heat and fresh air, in order to bring the cost of repair work down to the lowest point; the repair shop must be equipped with the best machinery, and not with tools which have been discarded from the main shop because no longer fit to use.

One of the points which seems to have been overlooked in designing roundhouses is the installation of the labor-saving devices which are considered absolutely essential in the main shop. A general locomotive repair shop without cranes of some sort would be almost useless for any kind of repair work, either light or heavy. But is there not almost as much need of cranes in engine houses as in shops? They would be such a distinct advantage in so many ways that they would pay for themselves over and over in the saving of labor and in lessening the time required to make repairs. Most of the parts of the modern locomotive are proportionately as much heavier than the same parts of the locomotives of fifteen years ago as the whole machine is larger and heavier than the engines which they have replaced and, in short, the methods in use ten years ago in making roundhouse repairs are no longer practicable; often no longer possible. A single instance observed recently is typical of what occurs daily in many engine houses. A heavy freight engine had been

run into the roundhouse, and in order to make some necessary repairs one of the side rods had to be taken off. As many hostlers, sweepers and laborers as were in sight were called to help on the job. After much time and effort had been spent, it was found that more men were needed; and, none being within call, the men already gathered, stood idle while additional help was obtained from outside of the engine house. With a crane at hand, the job could have been done in a fraction of the time and by two or three men.

In some roundhouses overhead traveling cranes have been erected. In others post cranes attached to the supporting columns of the roof between each two pits have been used. A somewhat roundabout method is that which the Santa Fe recently used on its enormous 2-8-2, Santa Fe type engines. A light crane is fixed to the side of the smoke-box above the cylinders and most of the heavy parts of the running gear in front of the cross-head can be handled with this. One reason, doubtless, why traveling cranes have not been put up in roundhouses, is the great difficulty of avoiding the smoke jacks. In some of the applications which have been made the crane has been placed adjacent to the inner circle, but this limits its usefulness in a great degree. Another method is to do away entirely with the smoke jacks and depend upon ventilation through the roof to dispose of the smoke. A third method employs forced exhaust ventilation. The pipes are fixed so as not to interfere with the crane, and the smoke jack is done away with entirely. Still another method is to use a telescoping smoke jack which can be lifted out of the way to allow the crane to pass. The installation of a traveling crane in a roundhouse is, of course, more difficult than in a rectangular engine house or shop where the main runway can be made straight. One of two methods is required to keep the crane always in a radial position. Either the wheels on the inside runway must be made of smaller diameter than those on the outside, or the traversing shaft must have a differential gear. Even with the most careful workmanship in building the crane and manipulation in handling it, the bridge cannot be kept in a true radial position, and it is necessary at least once or twice a day to run it up against squaring blocks placed on the runway. This, however, is not a serious objection, since the same thing must be done periodically on most cranes which run on a straight track.

Do American railroad men realize that within a few years they may wake up some morning to find that one of their most familiar acquaintances is no more? We refer to the American type locomotive. An American landscape without a railroad track would hardly be an American landscape; and an American railroader's imagination that does not contain one or more images of the ubiquitous eight-wheeler is inconceivable. Is there anything more familiar to all of us? Professor Goss, in the course of a discussion before the International Engineering Congress at St. Louis, referring to the work and worth of this type of locomotive, said:

"In the early days, it made little difference whether the service was freight or passenger, or whether the locomotive was for use on heavy grades or level track; the fitness of the American type was rarely questioned. As a response to early conditions, the type was almost perfect. Adherence thereto made the problems of the builder few and the cost of production low, and these were important factors at a time when track-mileage was increasing at enormous bounds. As the same patterns were used over and over again, the form and proportions of every detail were tested in service on hundreds of locomotives, hence the cost of maintenance was low. The type is well adapted to the rough track common in pioneer work, and is, moreover, very efficient as a steam power plant. . . . The decline of the American type is due to the fact that it cannot take on proportions which the modern locomotive must possess. Many different means were adopted in transforming the American locomotive of 1876 into the American locomotive of 1893. The boiler was raised above the frames that the fire-box might be made wider. The axle spacing of the driving axles was increased that the grate might be made longer, and wheel-loads were augmented that the tractive power might be increased; but when all of these measures had been carried to their limit, still more power was demanded, and the abandonment of the type became imperative. It is not unlikely, therefore, that a machine which for forty years has been in a remarkable degree typical of American railroad practice will soon disappear from the roads of this country."

And in its place we shall have to set our affections on the "hog," the "battleship" and the ungainly Atlantic—or else turn our affections into new fields. Perhaps our next new love (or that of our children) will be only a rectangular mass of iron, with little to distinguish it from a huge metallic mole except a copper wire sticking out somewhere!

Gross Earnings for August.

Railroad gross earnings for the month of August are favorable and indicate that on the whole traffic is on the mend; that the business depression may be near its end. For the month 97 railroads report an increase of $1,551,206 over August of last year. This is most encouraging when one considers that in July, 82 roads reported a decrease of $4,306,589. Of 72 of the more important roads reporting earnings, 42 show increases and 30 decreases. The final ending of the meat-packers' strike caused a freer movement in live stock and dressed beef, the shipments in these two commodities showing large gains over the shipments in July. There was also a much larger grain movement in the West, the high prices in the grain market apparently acting as a stimulus to shipments. Cotton, too, began to move in freer quantities than last year, the receipts at the southern ports being over 100,000 bales as against 6,000 bales in August, 1903. There was also a heavy increase in passenger receipts from the World's Fair business. The only adverse feature in the month was the depression in the iron and steel business; but this seems to have been more or less offset by a slight increase in traffic of a lower class. In fact, traffic has not really fallen off, but is heavier than last year at this time. To take an unfavorable view we must join those "optimists" who expect large gains to go on forever.

Gross earnings, when divided geographically, show that the largest proportionate loss was in the anthracite and southwestern groups of railroads and that gains were recorded in all the other groups, notably among those railroads running through the Southern and Middle States. Earnings arranged geographically may be summarized as follows: Southern group (12 railroads), increase $738,818; Middle and Middle-western group (14 railroads), increase $588,096; Northwestern and North Pacific group (14 railroads), increase $298,850; trunk line group (eight railroads), increase $150,188; anthracite group (five railroads), decrease $451,110, and Southwestern group (10 railroads), decrease $93,881.

Among the separate railroads showing considerable gains in gross were the Canadian Pacific (gain of $398,084); Wabash, $359,361; New York Central, $228,640; Southern, $287,545; Northern Pacific, $177,315; Chesapeake & Ohio, $174,490; Missouri Pacific (including Central branch), $157,000; St. Louis Southwestern, $125,650, and the Pere Marquette, $119,935. The heaviest losses were made by the Erie and the Lehigh Valley, which showed decreases for the month of respectively $351,721 and $344,110. The Denver & Rio Grande still appears to feel the effect of the labor troubles in Colorado, and showed a decrease in earnings amounting to $176,400. Other losses reported were: Great Northern, $153,585; Atchison, Topeka & Santa Fe, $150,398; Baltimore & Ohio, $119,096, and Reading, $118,124.

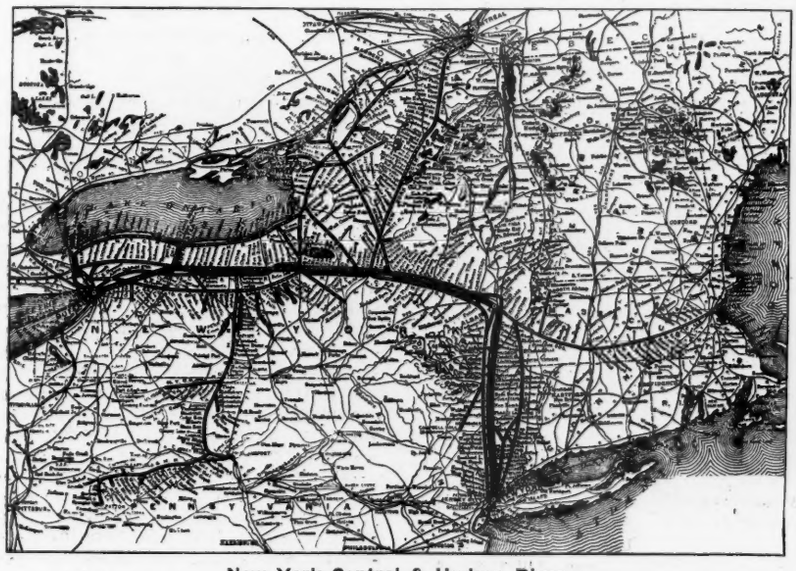
One Russian official seems to have won great credit during the war with Japan, and that is Prince Khilkov, the Minister of Transportation, part of whose early railroad training was obtained in this country, which he visited again a few years ago. When the war broke out, the line east of Lake Baikal, which was not entirely complete, had stations on the average 35 miles a part, and it was possible to pass very few trains daily—quite as many, doubtless, as the commercial traffic was likely to require. The war changed all that; vast forces must be carried over the road and supplied. The preparation for this naturally began immediately. Rolling stock was brought from Europe and carried across the ice of Lake Baikal, and many additional sidings built; while work was pushed on the very difficult line around the south end of that lake, which it had not been expected to finish for two years to come. This railroad is not yet open, but the improvements of the line west of the lake have been proved to be effective. A German who passed over the railroad from Manchuria to Europe writes to the Cologne *Gazette* that he traveled by the mail train from Kharbin to Irkutsk in seven days, including the passage over the lake and 12 hours delay at the Chinese border. He counted the trains which were met and found them to be 14 to 16 daily; which means an average of about eight daily passing eastward by any stationary point. These trains consisted usually of 20 to 25 cars, marked to carry 48 men or eight horses each (what we would call box cars); but usually not having more than 30 men per car. It appeared that about 2,200 men were forwarded daily, or 1,800 infantry, 500 horses, and eight pieces of artillery. Nowhere appeared any disorder in the movement. The mail train kept the time-table, which provides for a slow rate of speed. He was 16½ days going from Mukden to St. Petersburg, which is only 2½ days more than the time-table called for in time of peace. The operation of the road has been so much better than was expected that Prince Khilkov is almost deified throughout the empire.

Mr. Bion J. Arnold's presidential address before the International Electrical Congress at St. Louis, which is printed elsewhere in this issue, is a most rational and comprehensive statement of the probabilities of electric traction replacing steam. Although he treats the situation in a broad way and although critics might justly claim that the discussion is academic, his statements remain valuable for their fundamental truths. One point is particularly striking; the conception of the ideal conditions for electric traction on trunk lines. His idea would be to have two or more tracks, arranged in pairs, each pair of tracks being used exclusively for trains of one class running at approximately the same uniform speeds and making the same stops. In this way the heavy through freight could be handled in a large number of comparatively light trains running at medium speeds, instead of a few

long, heavy trains hauled by one or two powerful units. Much has been claimed about the future possibilities of electricity replacing steam on the great trunk lines; but mostly by men who have not given the subject careful study. Being filled with optimism, they have taken it for granted that because interurban passenger roads can make money out of local business, the same economies can be accomplished in handling through passenger and heavy freight business, and without much change in operating conditions. The success attained by interurban roads is due to the running of a comparatively large number of light trains, and the consequent equalization of the load on the power house at all times. This is an essential feature of the economy of electric traction, and the application of electricity to existing steam roads must necessarily conform to it.

New York Central.

The New York Central & Hudson River Railroad reports for 1904 a surplus from operations of $7,715,863, or 5.83 per cent. earned on the stock. But among the items



New York Central & Hudson River.

of extraordinary expenditure we find an item, "Additions to and replacement of equipment, and improvements to roadway and structures and charged to expenses $3,196,452." Unfortunately this total includes "replacements" which are not betterments but merely extraordinary renewals. If, however, in the absence of definite information, we consider the entire amount betterments we may increase the stated net income by this $3,196,452. The actual net income of the year then becomes $10,912,315, which amounts to 8.25 per cent. on the capital stock. It is probably safe to say that the road earned over 7 per cent. in the year just closed.

The mileage operated was this year 3,490, as compared with 3,423 last year, an increase of 67 miles. The increased mileage consisted of four spurs into the bituminous mine territory, providing outlets or additional outlets on lines of better gradients.

Much heavy work has been done during the year on the Pennsylvania Division. There has now been completed a water level line from the coal mines down the Susquehanna to a connection with the Reading for the low grade outlet to tidewater. The very heavy mountain sections have been avoided by the new links constructed, and the company is now able to haul 75 loaded cars with one engine over a section of 150 miles. Over this same section one engine formerly was able to haul but 20 loaded cars, and it required help at nine sticking points. The grade problem of the same division on the line to the north connecting with the New York Central main line is not so simple but the ruling grade is being brought to a practical working basis for heavy traffic. The capacity of this line for movement has been increased by construction of a second track, on the hills.

The grade of 40 ft. to the mile on the main line just west of Albany has been cut out by construction of the Schenectady detour. This is an important piece of work. At New York city good progress is being made in the great plan of depressing the yard at the Grand Central terminal, erection of a new terminal station and electrification of the first 30 miles north of New York. The report is exceedingly meagre in information about the large plans for electrification and for control of the trolley lines throughout its territory. New York Central is probably well in the lead in the movement by railroads to use electricity where practicable; but the officers are naturally cautious in giving details. The financing of the year was as follows:

Resources.	
Liabilities increased:	
Funded debt	$5,346,045
Current liabilities (net)	5,385,008
Profit and loss	20,673
	$10,751,726
Application of Resources.	
Assets increased:	
Cost of road	$3,641,567
Stock ownership in other lines	313,200
Ownership of other property	3,896,929
Advances to lessor and other companies (net)	693,306
Sinking fund	238,805
Liabilities decreased:	
Special improvement fund	1,967,919
	$10,751,726

These changes are not great. The increase in funded debt of over $5,000,000 was due to the issue of bonds for the terminal improvements. Being debentures they will not harass operations in any period of declining earnings. The increase in current liabilities of over $5,000,000 was due to the withdrawal of over $2,000,000 of sinking fund assets, by purchase of bonds and their reappearance under the head of "ownership of other property." This accounts for $2,000,000 of the increase in "ownership of other property," while the balance is composed of the cost of a coal mining property and sundry smaller items. The income account stated comparatively with that of the year previous is:

	1904.	1903.	Inc. or Dec.
Earnings	$77,682,221	$77,605,777	$76,443 I.
Expenses	55,760,061	53,459,314	2,300,746 I.
Net	$21,922,160	$24,146,463	$2,224,303 D.
Other income	6,005,981	5,272,744	733,236 I.
All income	$27,928,141	$29,419,208	$1,491,066 D.
Deductions	20,212,278	20,394,904	182,626 D.
Net income	$7,715,863	$9,024,303	$1,308,440 D.

The net income has fallen off 14 per cent. The factors to this result are, first, increased expenses; second, increase of other income due to raising of the Lake Shore dividend; third, reduction in the interest charges due to refunding. The final result therefore we see was saved by financial rather than operating considerations. The earnings were:

	1904.	1903.	Inc. or Dec.
Freight	$46,233,675	$46,858,712	$625,037 D.
Passenger	24,050,121	23,581,575	468,545 I.
Express	2,615,894	2,387,938	227,955 I.
Mail	2,405,312	2,398,284	7,028 I.
Rentals	2,208,270	2,175,076	33,194 I.
Miscellaneous	168,945	204,189	25,243 D.
Total	$77,682,221	$77,605,777	$76,443 I.

The loss in freight earnings was offset by a slightly greater increase in passenger, mail and express revenue, so that the earnings for the year were practically stationary. On the whole the result is a good one, for the year 1903 was a phenomenal one in the history of this road. Its earnings that year increased nearly $7,000,000 over 1902. It has done well to maintain the same high level this year.

The decline in freight earnings was due to a still larger decline in ton miles, offset by a 5 per cent. increase in the ton-mile revenue. The passenger business has shifted largely from way passenger business to through movement. This is said to mark the inroads of the trolley.

The general detail of expenses is:

	1904.	1903.	Inc. or Dec.
Maint. of way	$10,090,892	$10,469,570	$378,677 D.
Maint. of equip	11,358,295	10,882,375	475,919 I.
Sinking fund	32,289,026	30,317,129	1,971,897 I.
Gen. expenses	2,021,846	1,790,238	231,607 I.
Total	$55,760,061	$53,459,314	$2,300,746 I.

The increase in expenses did not lie in maintenance, but in conducting transportation and general expense. It amounted here to $2,200,000. With a decrease of nearly 6 per cent. in revenue ton mileage there was an increase in transportation and general expense of nearly 7 per cent. The explanation offered is the severity of the winter, the advance in wages, and the higher prices and wages.

The general results of the year may be summed up as not bad in view of the extreme conditions imposed. They are encouraging because they are no worse. The labor situation appears to have become a serious element in expenses. Many of its problems lie beyond the solution of a single road. The management are to be congratulated that they held their own so well.

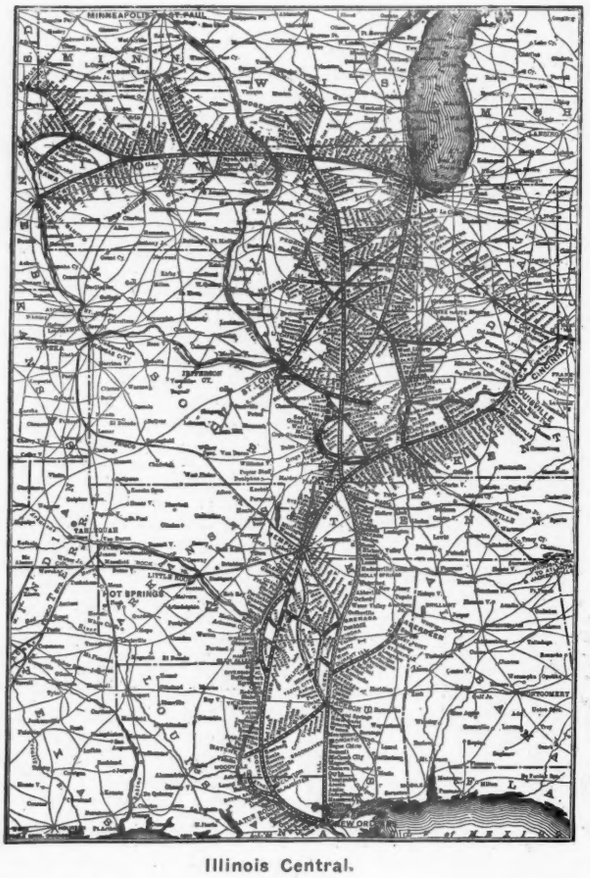
Illinois Central.

For the year ending June 30, 1904, Illinois Central earned $8,865,927, or 9.33 per cent. on its capital stock. This was a decrease from the net income of 1903 of $1,863,466, or 17 per cent. The dividend paid was $5,702,400 (6 per cent.). There was little change in the mileage. Some 47 miles were added during the year by construction and purchase. The largest single piece thus added was the 32 miles from East Cairo to Paducah, Ky. The rest of the new mileage consisted of half a dozen short spurs.

The equipment roster was increased by purchase of 83 new locomotives, 2,466 new freight cars, and 34 new passenger cars.

The expenditure for new construction and new equipment aggregated nearly $10,000,-

000. Over $6,000,000 of this amount was applied to the roadway and structures. The money there spent was devoted mainly to increasing running facilities, comparatively little being put into yards, terminals or buildings. Thus $3,142,000, or more than half of the entire outlay upon the roadway and structures, went for second main track and a half million more for sidings, and $952,000 for change of grades. There was more attention paid to the condition of track for $312,000 went to grading and track laying and



Illinois Central.

$182,000 for ties and rail fastenings. This latter is described as "construction." It therefore was not renewals but must have been due to raising the type of track maintenance. Of the entire outlay for new equipment and roadway of nearly $10,000,000 over 26 per cent., or $2,597,000, was charged to income, the remainder being charged to capital account except for a small amount ($273,000) defrayed from a special fund. The financing of the year is indicated below.

Resources.

Increase of liabilities:	
Funded debt, Illinois Central....	$12,168,750
Funded debt and stock of subsidiary lines	3,328,300
Special funds	12,975
Decreased assets:	
Advanced to other roads.....	2,558,976
Current assets	11,571,662
	$29,640,667

Application of Resources.

Increased assets:	
Road and equipment	$9,415,461
Real estate	12,025
Materials and supplies	566,273
Stocks and bonds	16,144,297
Subsidiary lines	3,328,300
Special funds	174,311
	$29,640,667

It will be seen that about a third of the $29,640,667 increased resources went into roadway and equipment. Subsidiary lines absorbed $3,328,000, and $16,000,000 were put into stocks and bonds, but $12,162,000 of this is an offset to the increase in the funded debt, $12,162,000 of the bonds of the company being still in the company's treasury. The remainder of the $16,000,000 increase in stocks and bonds is due to the financing of the advances to the Yazoo & Mississippi Valley into 3½ per cent. gold bonds to the amount of $2,245,000. A similar change has been made from the form of advances against subsidiary lines to securities of the Dubuque & Sioux City Line, $571,000.

Summing up the financing of the year Illinois Central has laid out a plan for taking over into one financing consolidation the subsidiary properties which it has so far been operating by control of stocks. But it has not proceeded further upon this schedule than the issue of $12,162,000. Because it has not marketed the bonds which it has issued it has drawn heavily upon current assets and created a floating debt of $3,000,000, while bills receivable and loans on collateral have been reduced over $6,000,000, and open accounts with solvent companies nearly $2,000,000. This reflects the unfavorable condition of the market for railroad securities during the year, and cannot be looked upon as a reflection on the company's credit.

The physical condition of the property is apparently very high. The average weight of rail in main track is 72.78 lbs. to the yard. The average capacity of a locomotive on general level track is 3,734 tons, or 5 per cent. greater than last year. The average capacity of revenue freight cars has been pushed up from 32.87 to 33.77 tons during the year.

Below is the income account for 1904 compared with 1903.

	1904.	1903.	Increase.
Earning	$46,831,135	$45,186,076	$1,645,059
Op. exp. & taxes	34,735,682	31,697,955	3,037,727
Net earnings.	$12,095,453	$13,488,121	*$1,392,668
Other income..	2,716,548	3,461,147	*744,599
	$14,812,001	$16,949,268	*$2,137,267
Rentals and int.	5,946,075	6,219,876	*273,801
Net income..	$8,865,926	$10,729,392	*$1,863,466
Betterments ..	2,579,329	4,881,253	*2,301,924
Balance	$6,286,597	$5,848,139	$438,458

*Decrease.

The salient facts in these figures are the small increase in earnings and the large increases in expenses and taxes. When the decrease of over $700,000 in other income is added we have a final net decrease of nearly $3,000,000. The adjustment for this is made by the reduction of the betterment appropriation of the year, so that the surplus for dividend is kept at about the same as last year. The central feature of the whole exhibit is expenses, in which the main points are:

	1904.	1903.	Increase.
Maint. of way..	$5,679,310	$5,909,195	*$229,885
Maint. of equip.	7,323,343	6,274,586	1,048,757
C. T.	18,785,938	16,676,332	2,109,606
General exp....	1,004,658	975,768	28,890
Total	$32,793,251	$29,835,883	$2,957,368

*Decrease.

The increase in actual business handled was only a little over 1 per cent. If we look at it from the standpoint of the actual dollars we find that with its better rates the average business done in 1904 brought in $1,645,059, but the added expense of transportation alone was $2,109,606, or a half million more than the added money taken in. The management frankly calls attention to the excessive increase in expense and explains it as due to the severe winter, the higher cost of coal, and the increase in wages. The last named cause accounts for over $1,200,000 of the entire increase. To these explanations they might have added a fourth in part resulting from the weather conditions, namely, the decline in train load from 289 to 277 tons. It reflects in part also the inferior balance of traffic this year. Altogether Illinois Central has had a rough time of it in operating this year. But its resources are so ample that it is easily able to absorb the irregularities of the year's results, in the amount of its betterment appropriation. It remains for the management to demonstrate in this coming year whether transportation expense has permanently shifted to this higher level. So far as the annual report would indicate the use of big engines and large cars has failed to work the economies expected from them.

Norfolk & Western.

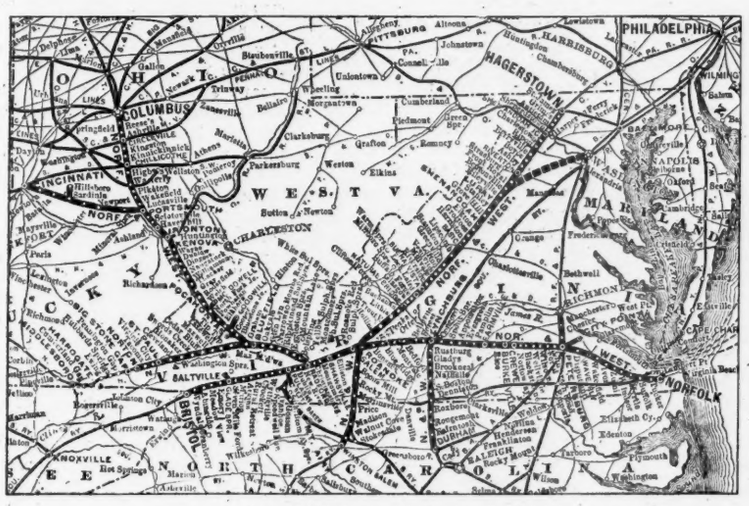
The report for the fiscal year ending June 30 shows gross earnings of $22,800,991, or $1,640,316 more than the previous year. Operating expenses increased $1,516,299, leaving a gain in net earnings of $124,017. The increase in receipts is due largely to the active traffic in bituminous coal, which contributed about 50 per cent. of the total tonnage moved. The shipments of this commodity alone increased 554,648 tons. This more than offset the losses in other commodities caused by the decline in the iron and steel industry. The ton miles increased nearly 20 per cent. The average ton-mile revenue on all freight was 4.93 mills, as against 4.86 mills in 1903 and 4.63 mills in 1902. The number of passengers carried was 3,594,965, an increase of 425,391, which makes a total increase during the past six years, since the reorganization of the company, of over 100 per cent. The growth of freight and passenger traffic and the maintenance of rates, enabled the company, notwithstanding adverse circumstances, to set aside $2,000,000 for betterments, besides paying the regular dividends of 4 per cent. on the preferred stock and 3 per cent. on the common.

During the year, the funded debt was increased by the issuing of $3,500,000 first consolidated mortgage bonds, the proceeds being used to liquidate expenditures made in former years for capital account. The extra interest on these bonds caused an increase in fixed charges, so that net income decreased from $6,040,189 to $5,819,303. The sum of $368,333 for discount and commission on securities was, however, added to income account, leaving $3,156,973 to the credit of the profit and loss account, as against $3,000,588 last year.

The increase of $1,516,299 in operating expenses was not as large as the increase last year, for the reason that the company restricted all work which was not absolutely essential. As a result of the settled policy of the company to put and keep the property and equipment in the best possible condition for moving freight at the lowest possible cost, the road has been able to keep its operating expenses down through the recent business depression without materially hurting its position from an operating standpoint. The expenditures for maintenance of way and structures were $2,860,056, or prac-

tically the same as last year. The maintenance of equipment expenses for the year, $3,532,058, show an increase of about 16 per cent. over 1903. This, however, was caused largely by a heavy increase in the item of repairs to locomotives owing to the severe and protracted winter. Fuel also was extremely high. The heaviest charges were in the conducting transportation account, where the increase over last year amounted to $839,495, due in a large part to higher cost of materials and labor, as on every other road this year.

In accordance with its policy of constantly improving its property, the company completed, during the year, several spurs to coal fields, including the Tug Fork, North Creek and Widemouth branches. Grades were also reduced extensively on the main line so as to lessen the cost of hauling coal. The company expects to have its low-grade line from Naugatuck to Kenova, 59 miles, finished before the end of the year. The total mileage on June 30, 1904, was



Norfolk & Western.

1,769 miles, and the average mileage worked was 1,723, an increase of 10 miles over 1903. The more important statistics of operation follow:

	1904.	1903.
Average mileage worked	1,723	1,713
Gross earnings	$22,800,991	$21,160,675
Freight earnings	18,894,941	17,676,349
Passenger earnings	3,150,859	2,841,491
Operating expenses	14,213,730	12,697,430
Maint.-of-way and struc.	2,860,056	2,754,199
Maint. of equipment	3,532,058	3,041,414
Conducting transportat'n	6,853,963	6,014,468
General expenses	967,653	887,348
Net earnings	8,587,261	8,463,245
Net income	5,819,303	6,040,189
Surplus	3,156,973	3,000,588

Missouri, Kansas & Texas.

The report of this company covering its operations for the 12 months ending June 30, 1904, covers 283 miles more than the last previous report. In the year ending June 30, 1903, the mileage worked amounted to 2,601, while this year it was 2,884. The total mileage operated at the end of the year was 3,043, an increase of 329 miles. Gross earnings increased $558,492, but there was an increase of $536,339 in operating expenses, leaving as a gain in net only the trifle of $22,153. Of the total receipts, freight earnings contributed $13,102,909, a decrease of $153,991, the aggregate tonnage for the year being only 5,204,103 tons, as against 5,319,968 tons in 1903. This loss in freight traffic is chiefly in coal and grain, President Rouse estimating the loss in grain tonnage alone at 11,000 cars for the year. It is undoubtedly a fact that the Missouri, Kansas & Texas is feeling the effect of the large growth in the export traffic at Galveston and New Orleans. The grain traffic which was formerly carried to the northern and eastern ports by this company's lines has lately been drawn towards the southern ports. The company seems, however, to be developing a fair local traffic and the losses in coal and grain were partly offset by a gain in merchandise and other high-class freight, resulting in an increase in the average receipts per ton-mile from .95 cent to 1.06 cents. Passenger earnings increased $641,747 and mail and express earnings $66,381.

Large additions were made to motive power and equipment during the year, the increases including 56 engines, 1,050 freight and miscellaneous cars and 44 coaches. Contracts have been let for the delivery in October of 27 engines and 1,825 miscellaneous cars. Payment for this equipment has been arranged for by a series of notes, the aggregate outstanding obligations of this kind now amounting to $4,315,896. To pay for new equipment bought during the year, an appropriation of $5,353,943 was made from the income account.

The report speaks of the plan of the directors for providing capital for future improvements and extensions, and also for the redemption of the various divisional mortgages now in existence, by the creation of a "refunding first mortgage" to the amount of $40,000,000. Action of this kind would release the surplus earnings (which in the past have been used for improvement purposes) for the payment of dividends on the preferred stock. In case this should be done, the surplus which now is $1,066,368, would suffice to pay 4 per cent. on the $13,000,000 outstanding preferred stock, and about 1 per cent. on the common stock of the company. The more important statistics of operation follow:

	1904.	1903.
Average mileage worked	2,884	2,601
Gross earnings	$17,766,595	$17,208,193
Freight	13,102,910	13,256,900
Passenger	3,802,202	3,160,455
Operating expenses	12,659,470	12,123,131
Conducting transportat'n	7,521,054	6,913,309
Maint. of way and struc	2,690,226	2,779,995
Maint. of equipment	1,613,969	1,681,076
Net earnings	5,107,126	5,085,062
Surplus for the year	1,066,369	1,099,916

NEW PUBLICATIONS.

Webster's International Dictionary, Twentieth Century Edition, edited by W. T. Harris, Ph.D., LL.D., United States Commissioner of Education; 2,380 pages and 5,000 illustrations. G. & C. Merriam Co., Springfield, Mass.

A new and enlarged edition of Webster's International Dictionary has recently been published. It is called the Twentieth Century edition and contains a 234-page supplement in which are 25,000 additional words. The biographical dictionary has been thoroughly revised and contains the names, nationality, occupation, etc., of 10,000 noteworthy persons of ancient and modern times. The gazetteer has also been revised, and the figures for population and area are compiled from the census returns of 1900 and 1901. New plates have been made for the whole dictionary, so as to insure that the typographical excellence of the work shall not be impaired.

TRADE CATALOGUES.

The Franklin Institute, Philadelphia, Pa., is distributing its announcement and programme of lectures for 1904-1905. A brief description of the Institute, including the library, the lectures, the schools, the exhibitors, etc., are given. It states that at the present time the library contains 57,534 volumes, some 42,274 pamphlets, 2,861 maps and charts, and 1,241 photographs. These are all classified and catalogued and are exclusively scientific and technical in character.

The Lidgerwood Manufacturing Company, New York, is distributing its new cableway catalogue. The book measures 9 in. x 12 in., and contains 160 pages. It is liberally illustrated throughout with both line and half-tone engravings, which show installations of the Lidgerwood cableways in all parts of the world. Details, performances, illustrations, etc., of cableways used in the construction of canals, dry docks, dams, locks, filter beds, piers, log handling, fortifications, open pit mining, quarrying, etc., are given. Illustrations and descriptions of the Lidgerwood-Miller marine cableway for coaling vessels at sea are also shown.

The Royal Blue for September, published by the Baltimore & Ohio, is a special World's Fair issue. It contains a long article by Major Pangborn describing the interesting exhibit of historical locomotives representing every step in the advancement of engine building, which the B. & O. has placed in the Transportation Building. Another article by the same author gives some figures relating to the value, power and weight of the exhibit of modern locomotives at the Fair. Much useful information for visitors is given in the last few pages, including an itinerary for a three-days' visit to the grounds.

American Blower Company, Detroit, Mich., sends catalogues Nos. 162, 163 and 164. The first two are devoted to "A B C" vertical engines, Type F and Types B and C respectively, and the last to "A B C" horizontal engines, Type I. These various types are described in detail, and the different styles of each illustrated. A sheet and list of repair parts are given, also tables of dimensions. Another smaller pamphlet is devoted to "A B C" fans and blowers, giving illustrations, descriptions, price lists and dimensions.

The Transit Finance Co., Philadelphia, has published a little book on the development of electric traction in the United States, in which are set forth the practical considerations involved in the building of electric railroads and some interesting facts about the

value of traction securities. The book contains in condensed form some interesting statistics of interurban electric railroads and is an attractive prospectus of the business of this company, which is to promote and build electric roads.

The Wellman-Seaver-Morgan Company, Cleveland, Ohio, is distributing an illustrated pamphlet descriptive of the "Akron Chilian Mill." This mill is used for the wet grinding of metalliferous rock. The mill is made in two sizes, 5 ft. and 6 ft. respectively; the 5 ft. size has a capacity for grinding 25 tons in 24 hrs. and the 6 ft. size will grind 50 tons in 24 hrs. Illustrations and full descriptions of the details of the mill are given.

The Art Metal Construction Company, Jamestown, N. Y., maker of incombustible furnishings and metal filling devices, issues an illustrated pamphlet descriptive of the fireproof offices of Hibbard, Spencer, Bartlett & Company, Chicago, Ill. These offices are completely equipped with metallic fixtures and furniture.

The Allegheny Forging Company, Pittsburg, Pa., issues price lists of its chain, hot pressed and cold punched nuts, plate and cast washers, and of rivets and burrs. These lists are published in separate folders and each folder contains useful information in regard to the subject dealt with.

CONTRIBUTIONS

Concrete Cross-Ties.

Joliet, Ill., Sept. 27, 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your issue of Sept. 23d I notice an article describing some concrete cross-ties in use on the Ulster & Delaware. In the article you state that the cost of the tie is 42 cents exclusive of the cost of reinforcement. Is there not some mistake about this? I figure that the cement alone in one tie would very nearly cost 42 cents.

ARTHUR MONTZHEIMER,
Chief Engineer, Elgin, Joliet & Eastern.

[Our information came from the designer of the ties and we have no other means of verifying the cost.—EDITOR.]

Block Signals Which Are Not Stop Signals.

The Lake Shore & Michigan Southern Ry.,
Cleveland, Ohio, Sept. 28, 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Permit me a word to supplement the quotation in your issue of Sept. 23, from my remarks at the Chicago meeting of the Railway Signal Association.* Most roads are using the following night signal indications:

Home Interlocking Signals.

Color—Red light.

Indication—Stop at or before reaching the signal.

Significance—If a train over-runs the signal (generally located 50 ft. in the rear of a derail) it will be derailed or will foul another track and quite possibly another train.

Home Telegraph Block or Train-Order Signals.

Color—Red light.

Indication—Stop.

Significance—This stop indication means that there are orders for the train or that the block is occupied, and simply requires the train to stop at the block station where the signal is displayed and not leave until the signal is cleared or proper order, or caution, or a clearance card is received.

In general practice a passenger train is permitted to pull past this signal, indicating stop, a sufficient distance to discharge and receive passengers and baggage, and freight trains commonly pass same at 20 miles an hour; 19 orders, caution or clearance cards being delivered by hoop on the fly.

On the Lake Shore, as on many double track roads handling trains of from 70 to 100 cars, to bring them to an absolute stop for every "pass the block" order or card would cause unbearable delay. While the engineman is held to strict responsibility for always knowing where he is, we cannot be blind to the cold fact that there are many moments, possibly vital ones, when from smoke, steam, snow, fog, distracted attention, a cinder in the eye, etc., he may lose his bearings, and that system of signal lights surely seems defective which gives him the same night indication at an open derail that it gives at a point past which he is permitted, by inference and by practice at least if not by definite rule, to pull a portion of his train before stopping, or at which he may not have to stop at all if the expected order, caution or clearance card is passed up to him on the hoop. This serious inconsistency may be obviated in two ways: First, by requiring trains to stop *at or before reaching all signals* indicating stop. Second, by providing a distinctive night indication for telegraph block and train order signals.

The first means may be used where these signals are put far enough in advance of the block stations to admit of station stops for passenger trains being made in rear of the signal, and where freight trains are so short and infrequent that the delay occasioned by stopping them dead before reaching any block or train order signal indicating stop, could be tolerated. The stopping of heavy trains is theoretically correct but on a great many roads entirely impracticable.

The second method is theoretically proper and easy, but little used. The writer has experimented with separate fixed purple lights placed about 18 in. below the lamp giving the "stop" and "proceed" indications; and results so far indicate: First, that the purple light can be seen under average weather conditions, about 1,200-ft. Second, it shows purple as far as it is visible as a light. He believes it will be a sufficient marker for the train order or telegraph block signal to permit of the air being released and the train permitted to drift by the signal, after speed has been reduced at sight of the more distantly visible red. If the purple marker light should be extinguished of course absolute stop would be made at or before reaching the signal.

On many lines it is of great advantage to have all orders to take siding at next block station given by a fixed signal instead of by written order; and where the arm displaying this latter indication is carried on the same mast with the home block or train order arm, it would probably have to show the same light at night as does a caution signal, and the combination of a red light or a white light over a green light (or yellow where that is the caution color) on the same mast would need the marker light (purple) to distinguish it from an automatic block. A differentiation of some kind is imperative, as any fixed signal indication directing a train to take siding at the next block station, would, of course, have to be acknowledged by proper whistle signal.

I shall be grateful for any suggestions on this matter.

AZEL AMES, JR.,
Signal Engineer.

*Mr. Ames said, at Chicago: "A red light is used for an open derail; and a man who goes by that light 50 ft. goes on to the ground. We also use the same on train-order signals, where it is not an absolute stop signal. There are roads where the train-order signal requires an absolute stop before reaching it, but not many; and with heavy freights you cannot afford to require it. . . . We are going to display on our train-order signal masts 18 in. to 20 in. below the regular light, a fixed purple light that cannot be seen more than about 1,200 to 1,500 ft. away."

Rail Fastenings.

Mr. A. Morrison, of the Cambria Steel Company, presented a paper on this subject at the St. Louis meeting of the Roadmasters' and Maintenance of Way Association. Having referred to British and Continental practice he said:

Our experience is that when track is properly drained, ballasted and tied, almost any kind of rail fastening will do satisfactory work. It is not a question of providing material for the most favorable conditions, but it is a question of material that will give good results under moderately unfavorable conditions. In Great Britain tie renewals are made by special gangs. The work is so laborious, on account of the complex fastenings, that a section gang would never get through with the work.

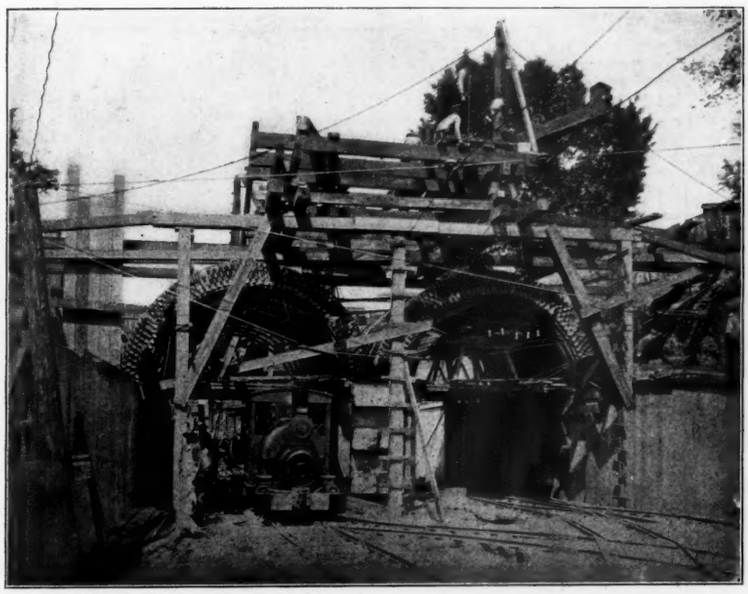
Fifteen years ago I used screw spikes, which had a projecting head on one side to engage the rail base. The idea was that when changing rails all that we had to do was to give the screw spike a quarter turn with the wrench, lift the rail out, then put in the new rail, and turn the head back to place again. That looked very attractive, but we found that when the wrench was applied to these screw spikes they were rusted fast to the tie, and to get the rails out we had to break the head off every one of them.

A general manager of an eastern road related his experience with screw spikes, when he was assistant engineer in charge of construction on a new road, as follows:

"The ties were bored with a boring machine, which put down the four holes with one operation. The screw spikes had clips on two sides. It seemed impossible to get the head to fit with exactly the right pressure on the rail base. The heads were either loose on the rail, or so tight that the head snapped off, and I have seen bushels of these heads along the line of the track. The screw spikes rusted badly, and after a while could not be turned. They were not a success and none were used after the first laying of track."

A test with lag screws, as a rail fastening, was made on a mountain grade on an eastern railroad a few years ago. The track was laid with large oak ties, and heavily stone ballasted. The pushing engines on this grade were exceptionally heavy, and as a natural consequence they created considerable wave movement of the rail, which meant a corresponding lifting of the heavy oak ties, where the screws were used. In many cases, however, instead of the ties responding at once to the rail movement, the heads of the screws would let go, and as a result several of the trackmen were more or less severely injured.

I have mentioned these cases to show that when lag screws or screw spikes are used, they hold the tie to the rail so firmly that the ties must either lift with the rail, or the heads fly off. No trackman would for a minute deem it proper for the ties to work up and down on the ballast. You all well know from hard experience what the result would be. (1) The tamping would be destroyed by displacement of the ballast. (2) Where the sub-grade was imperfectly drained the ties would pump mud. (3) Center bound track is more quickly formed



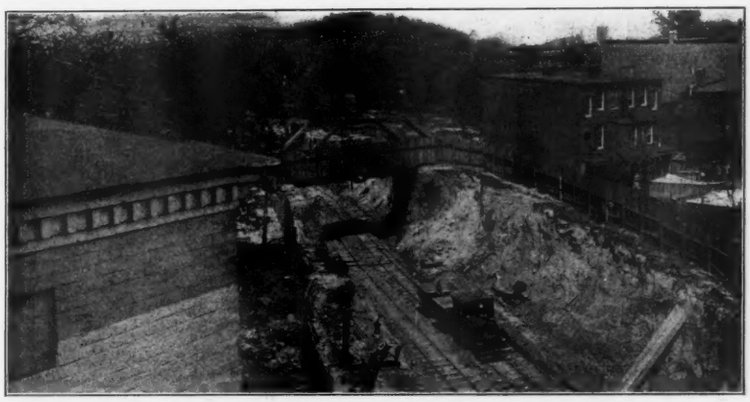
South Portal Showing Twin Brick Arches.

where the ties are working than under any other condition.

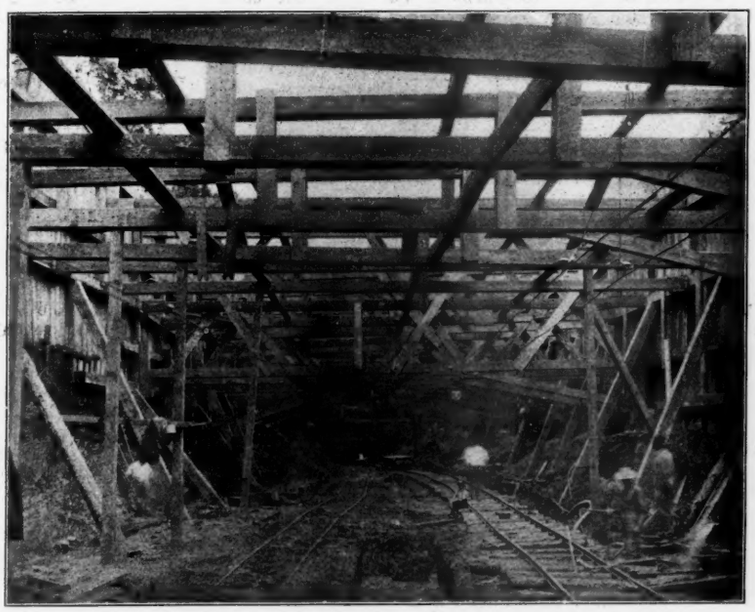
The ideal conditions require that the tie be solid on its bed, so that impact from the rail be received by the tie and distributed to the sub-grade by the ballast. With the use of screw spikes the impact is exerted by the tie on the ballast with a pounding action which disturbs, displaces and destroys the material which gives as well as receives the impacts by every passing wheel.

The use of lag screws requires the previous boring of holes, and where dowels are used, larger holes must be bored for them. If greater adhesion is wanted, why not do the same thing for the spike? A hole bored for a spike $^{1}/_{16}$ in. less in diameter than its thickness will materially increase its adhesion. If using cedar ties or other soft wood, drive the spike, then extract it, plug the hole with an elm tie plug, and finally drive the spike into the center of the plug. This will give 100 per cent. greater adhesion and lateral resistance, all of which is very much cheaper than using a lag screw; and when making renewals the spike can be pulled and the work proceed in the usual manner.

The cost of a lag screw is double that of a spike, and the cost of application about four times as much. Had the lag screw positive advantages, there would be some reason for incurring the extra expense, but instead there is absolutely no advantage, but a certain detriment, particularly when considered in connection with the conditions existing on the railroads in this country.



Excavation for Tunnel between the Capitol and the Congressional Library.



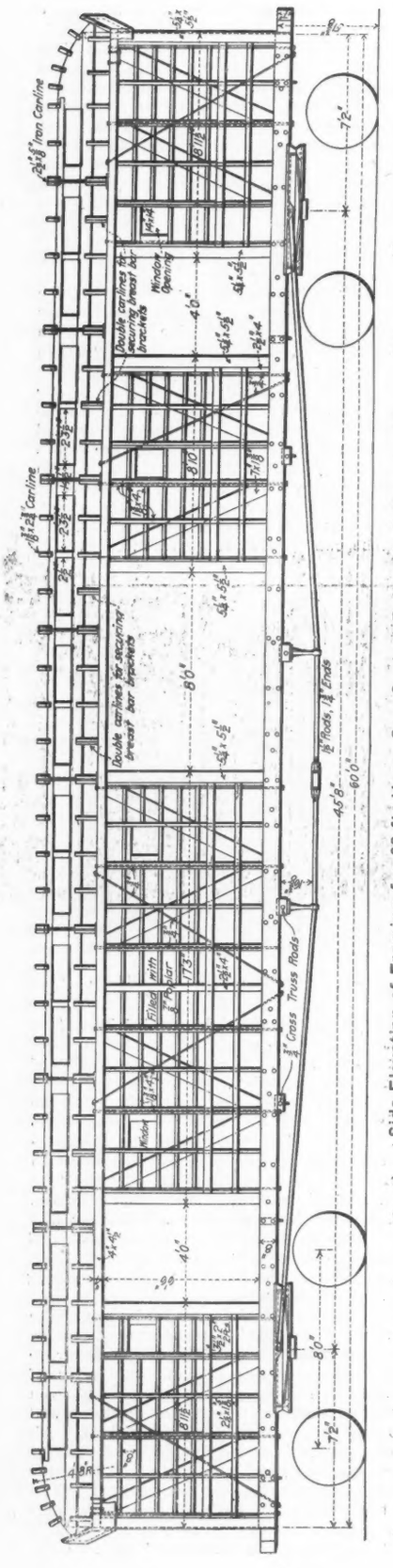
Timbering in Open Cut.

Progress on the Washington Tunnel.

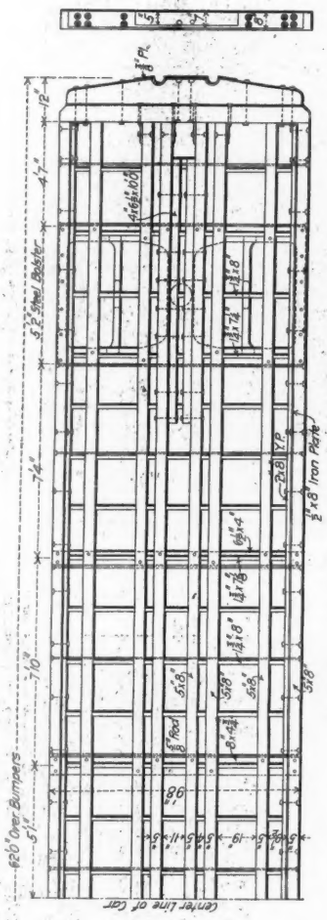
Good progress has been made during the summer on the Pennsylvania's tunnel under Capitol Hill, which will give that road an entrance from the South into the new Union station now building at Washington, D. C. The site of the new terminal is close by the present B. & O. station, and to give an entrance for trains of the Pennsylvania and all other roads coming in from the South this tunnel, 4,800 ft. long, is being built from a connection with the Pennsylvania's present line at Virginia avenue and Second street, under First street and Capitol Hill. There will be two parallel single-track tunnels 16 ft. wide and 18 ft. high, divided by a first class ashlar masonry wall and having concrete side walls. The arch rings consist of five courses of brick, the facing ring being of vitrified brick. The foundations for the side walls and center wall are concrete 6 ft. deep and 4 ft. wider than the thickness of the walls. For 1,200 ft. north of the south portal the work is being done by the "cut and cover" method with steam shovels. About 500 cubic yards are removed a day and about 500 ft. of the tunnel at the south end has been completed to date. Seventy-five feet of excavation, masonry work and back filling is being done a week.

In molding the concrete side walls, the forms used are steel plates instead of boards, and the results are said to be superior to anything heretofore done in this class of work. The walls have a smooth and even surface when the forms are removed and do not require patching or finishing. All the concrete is mixed in one plant located near the work, and when delivered from the mixer is loaded into buckets and carried on flat cars to the point where needed. Portable cranes run by electric motors are used to lift and dump the buckets off the cars and into the molds.

Besides the concrete work in the side walls, the filling over the haunches of the arch rings above the central dividing wall



Side Elevation of Framing for 60-ft. Horse Car, Central Railroad of New Jersey.

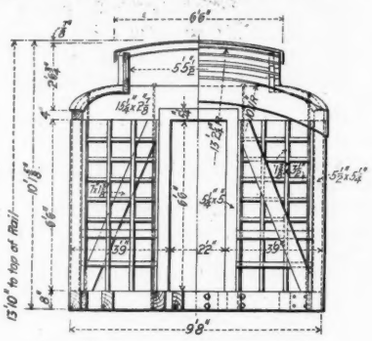


Half Plan of Floor Framing for 60-ft. Horse Car.

is also concrete. This is put in solid and is carried up in the center to a slightly higher level than the arch ring crown, giving a slope each way to the top of the twin tunnels. The whole top of the tunnel is covered with four layers of Hydrex felt laid in asphalt and covered with a thick coat of cement mortar. Along the side walls, gutters are run which are filled with broken stone. Water coming through the earth filling is drained from the roof of the tunnel into these gutters, and thence to perforated cap drains spaced at intervals of 50 ft. and connected with the city sewers. About 200 men in all are employed on the work.

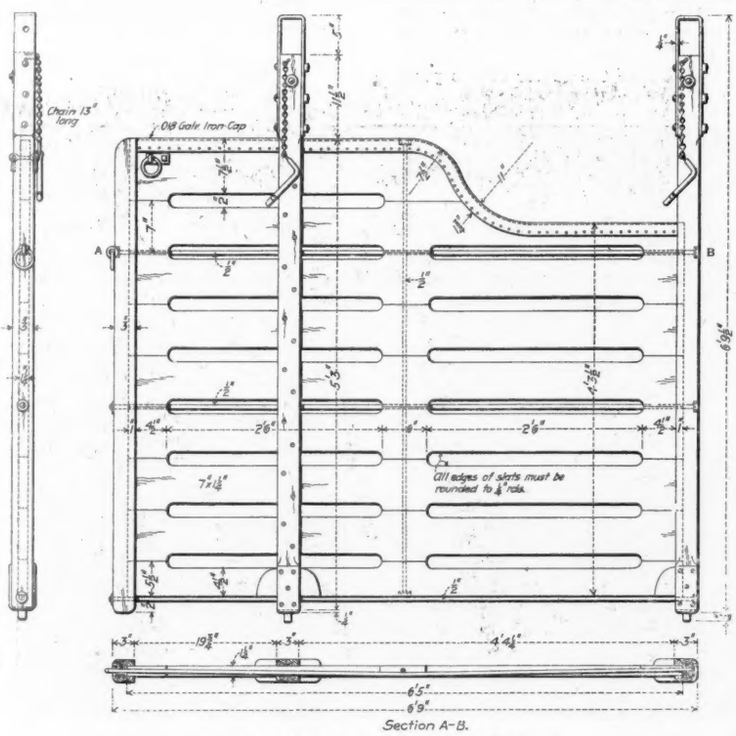
Special Horse Car for the Central Railroad of New Jersey.

The Central Railroad of New Jersey has recently completed a special horse car, 60 ft. long, at its Elizabethport shops. It is intended for carrying fine horses and carriages in regular passenger trains and is mounted

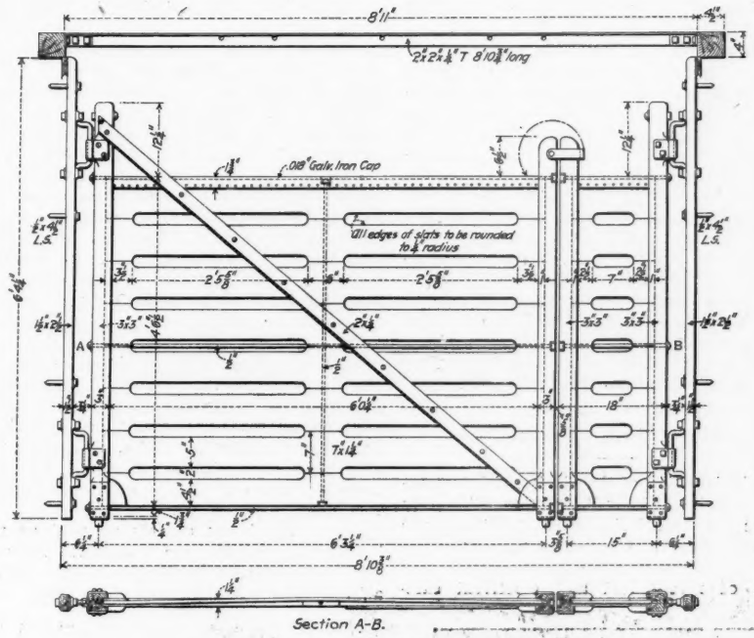


Half Section and End Elevation.

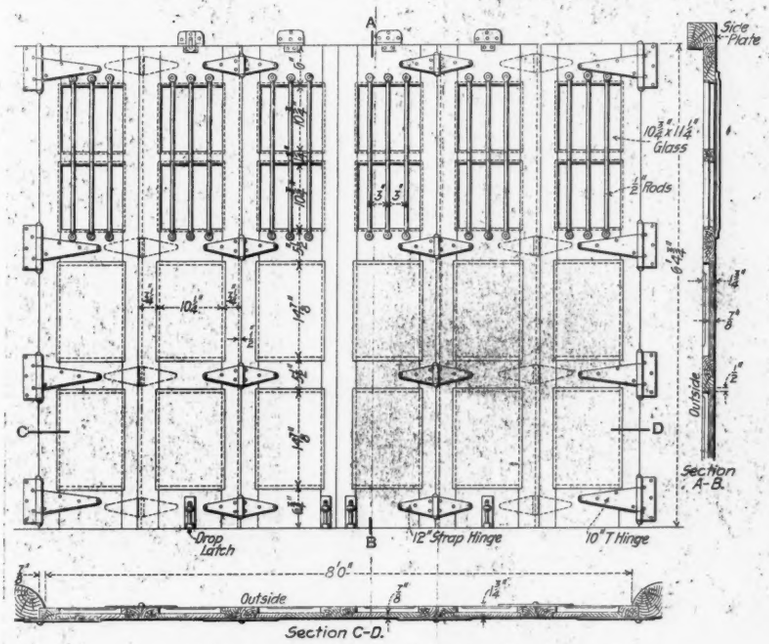
on standard four-wheel passenger trucks. It has stub ends and is fitted with Standard steel platforms and Buhoup three-stem couplers attached under the framing. The underframe is wood and consists of eight longitudinal sills, each 5 in. x 8 in., trussed with 1½-in. rods which are fastened at either end to the double cast-steel body bolsters. The



Stall Partition for 60-ft. Horse Car.



Transverse Partition for 60-ft. Horse Car.



Folding Side Door for 60-ft. Horse Car.

side framing is particularly heavy because of the wide door openings, of which there are three in each side, one being 8 ft. wide and the other two being each 4 ft. wide. The braces are 7 in. x 1⅜ in., and the door posts are 5¼ in. x 5½ in.

The interior of the car is divided into five compartments by movable cross partitions, and each of these compartments can be divided into three or four longitudinal stalls by stall partitions. There is room therefore for from 15 to 20 horses. The 8-ft. doors are near the center of the car and can be used for loading carriages into the large middle compartment. The cross partitions are hinged to the side of the car and are made in two parts, the narrow part serving as a gate in the passageway so that the attendant can go from one end of the car to the other. Iron strips, 2½ in. x ¼ in., are let into the floor under each cross partition and 1⅛-in. holes are drilled in them to take the pins in the bottom of the partition posts. Curved strips are also let into the floor to form a rail over which the partitions can be swung to the side without injuring the floor boards. A 2-in. x 2-in. x ¼-in. T iron runs across the car between the side plates above each cross partition, and the stall partitions are hung from these by the straps which extend up from the posts. Pins in the bottom of the posts fit in holes bored through the iron strips which are let into the floor. The holes in these cross strips are spaced for three and four-stall partitions. Breast boards across the front of each stall are supported in iron sockets fastened to the side of the car at the proper intervals, and when not in use these boards are lashed in wrought iron brackets over the side doors.

The narrow end doors slide open but the side doors are made folding in order to save the space inside the car which would be taken up by the door guard strips. The 8-ft. doors are made in two parts of three panels each, and the 4-ft. doors are made in a single part with three panels. They are fastened at the bottom with ordinary latch bolts. In addition to the doors, five small sliding windows are cut in each side, and these are protected with bar gratings on the inside. The car is lined with ⅛-in. steel plates on the sides and ends for a height of 5 ft. from the floor.

We are indebted to Mr. B. P. Flory, Mechanical Engineer, for the drawings.

Mr. Wallace on the Panama Canal.

Mr. John F. Wallace, Chief Engineer of the Panama Canal, was the guest of honor at a dinner given in Chicago, September 30, by the Illinois Manufacturers' Association, at which 400 manufacturers of Chicago and vicinity were present. Mr. Wallace was the speaker of the evening and began his address by referring to the fact that for over 400 years a passage across the isthmus in the neighborhood of the proposed Panama Canal had been the dream of navigators. Ever since Bilboa first viewed the waters of the Pacific ocean from the crest of the divide at Panama, the advantages of a short passage between the two oceans has been manifest. It was President John Quincy Adams who first appointed, in 1826, a commission to investigate and report upon the feasibility of a canal across the isthmus at Panama. So that the first steps on this project were taken by the United States, and not by the French, as is generally supposed. In 1848 the Panama Railway Company obtained its charter, the remarkable feature of which was, that an absolute monopoly was created which controlled every means of transportation within the country of Panama. It has been said that so sweeping were the rights conferred on this company that no one might independently even make a bridle path through the forest, and so rigidly did the company enforce its rights that it refused to allow persons to walk across the isthmus. Consequently the De Lesseps' French Company had first to buy the Panama Railway Company, and the property and charter of this company were among the assets transferred to the United States in the recent purchase.

The work of the French Company, which has been so much criticised, has paved the way for what we may hope will be our own success. The plans, machinery, and tools, and the great mass of records turned over to us by the French Company make an important foundation for the present Commission to build upon. There has been rather too much disposition on the part of Americans to refer slightingly to what was accomplished by the French. One of the greatest surprises to Mr. Wallace, during his recent residence of three months on the isthmus, was to find how much had really been accomplished and how valuable are the machinery and tools they have left for us. The United States can gain at least one-third of the time required to complete the work because of what has been done. Even the failures of the French Company are valuable, as they point out what not to do. It is extremely fortunate that the French failed to carry out their first scheme, of a sea level canal, 70 ft. wide by 30 ft. deep, for to-day less than 20 per cent. of the modern vessels could pass through such a canal.

One machine shop was found in the jungle filled with machinery equal to that in any shop of the Illinois Central railroad, with the exception of the three newest shops of that company. This shop has been overhauled and is now in complete operation. Over 3,000 dump cars and 300 good locomo-

tives are included in the property acquired, besides rails enough for 250 to 300 miles of construction tracks; many steam shovels and dredges also are included. While generally the wooden portions of machines have been destroyed by the climate it is surprising how little the metal parts have corroded.

The first work of the present commission, which will occupy two years, is to determine upon the most practicable plan to adopt. Plans are to be considered for high level canals having six, four, or two locks, or for a sea level canal having one lock at the Pacific ocean end. The estimates for a canal having six locks have been placed at eight years for completion, and at a total cost, including the 50 millions already paid, of 200 million dollars. Recent borings have resulted in establishing the fact that it will be more feasible to build a sea level canal than was at first considered possible; and while Mr. Wallace is not ready to make any definite recommendation to the commission at this time he feels that it is reasonable to consider that a sea level canal with one lock can be built by spending 50 millions more money, and 50 per cent. more time than would be required for the high level, six-lock canal. By this plan 36 million dollars of the estimate of the former commission for locks would be released and be available for extra excavation and river diversion work, including a seven-mile tunnel for flood waters. He is satisfied that the high level plan can be carried out within the estimate of the Isthmian Commission both as to time and money. There is a difference of 10 ft. between the mean tide levels on the two sides of the isthmus, and while the fluctuation of tide is less than two feet on one side, it is ten times as great on the other side, hence the need of one lock for a sea level canal.

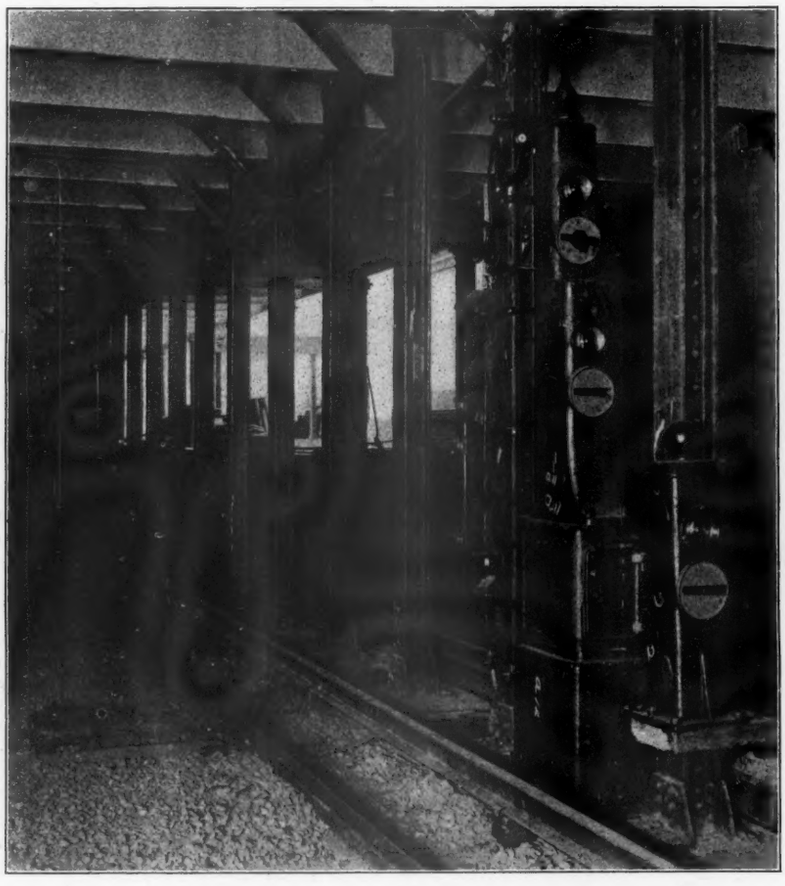
Mr. Wallace referred to the work now being carried on at Panama and Colon, including the building of water works, sewers and paving, all intended to make the sanitary conditions of the isthmus excellent. This work involves the expenditure of over half a million dollars. During the past three months he found the maximum temperature to be 86 deg. Fahr., and the nights cool. In concluding his address he paid a high tribute to Governor Davis, under whose administration conditions on the canal zone have been admirable. He denied that there had been any friction between Gov. Davis and himself, and incidentally stated that if there had been as many newspaper reporters on the isthmus as there are ties on the Panama railroad more misinformation could not have been published about conditions there than has been given to the reading public.

Signals in the Subway.*

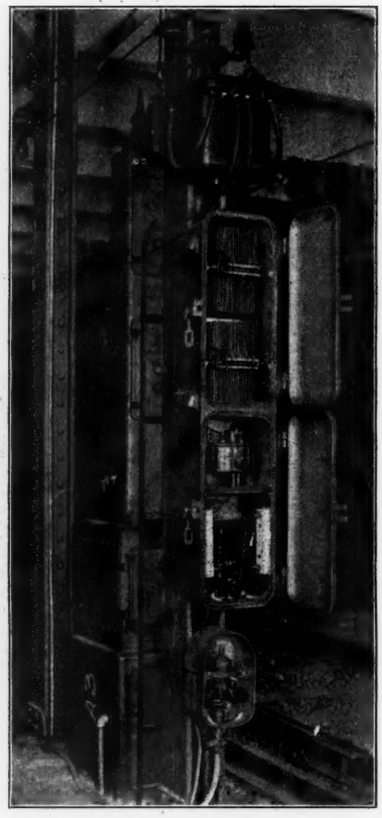
The installation of the block and interlocking signals in the New York subway involves at once the use of old and well-tried methods and appliances and also the application of some entirely new principles; and the provision of mechanical and electrical safeguards is more complete than anything that has been done before. The problem has been solved by a careful consideration of the local conditions and the location and connections of the signals are such as to give the greatest capacity to the line and the utmost flexibility in operation.

Between City Hall station and 96th street, a distance of 6½ miles, there are four tracks, the two middle tracks being intended for express trains. On these tracks the running conditions are quite similar to those on steam railroads and throughout their length they have automatic block signals controlled by track circuit. From 96th street to 145th street on the West Side division there are three tracks. Two of these are for local trains and the middle track is for express trains which will be run only in one direction at a time, running down in the morning and up at night. This express track is also to be worked by block signals. Above 145th street, where there are but two tracks, both tracks are block-signaled. The tracks for local trains between 145th street and City Hall have block signals only at the stations and on curves where the motorman's view ahead is obstructed. Conditions on these tracks are similar to those on the elevated roads where a complete block system has never been thought advisable or necessary owing to the frequency of the stops and comparatively low speed. Including the sections of local tracks at curves and stations, there are 24½ miles of track equipped with automatic signals.

All of the block signals as well as the interlocking signals are a modified form of the Westinghouse electro-pneumatic system adapted to the restrictions of clearance and lighting conditions in the tunnels. The distinguishing feature of the installation is the use of an alternating-current track-circuit for operating the relays controlling the electro-pneumatic valves on the signal posts. An electric track circuit for signals as used on the ordinary steam road is a comparatively simple problem compared to the one encountered here, in which the rails act as return feeders for a 500-volt direct current with amperage sufficient to propel a train requiring at times as high as 2,000 h.p. On the elevated and the subway lines of the Boston Elevated Railroad a direct current of low



Block Signal and Dwarf Signal with Automatic Stop.



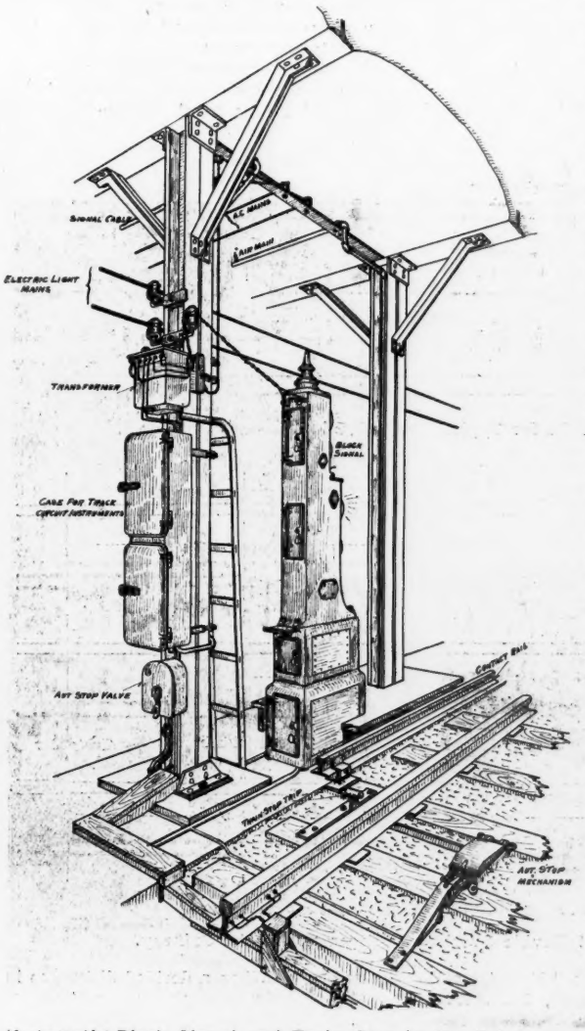
Rear of Signal Showing Auxiliary Apparatus.

*It is announced that the Subway will be opened for business from the present southern terminus (City Hall) to 145th St., on Oct. 27.

voltage is used, and with good results, but there the traffic is not so enormously heavy and the chances of derangement of the delicate mechanism of the signal relays by a sudden rush of current or drop of voltage in the return rail are not serious. Preliminary experiments made on the North Shore Railroad in California by the Union Switch & Signal Co., which installed all the signals, showed that an alternating current track circuit could be successfully used with a high-voltage direct-current return power circuit provided the return power circuit was carried through only one rail with the other rail insulated at the ends of the blocks and all of the automatic signals in the Subway were designed on that principle.

Current for the signal track circuits is supplied through 500 volt a.c. feed wires from the sub-stations, which run through the tunnel from end to end. Each signal post at the entrance of a block section carries a step-down transformer with two secondary coils, one of which delivers an alternating current of 10 volts for the track circuit and the other delivers an alternating current of 50 volts for the signal lamps. The low voltage secondary coils are connected across the rails at one end of a block section and the track relay is connected across at the other end of the block, with a choke coil interposed to keep out the direct current. The action of the relays is similar in every way to those used with continuous current circuits.

On account of the limited clearances in the tunnel and the conditions of night which prevail, the signals indicate by color and not by position. The appearance of the signal and its auxiliary apparatus is shown in the accompanying illustrations. The mechanism controlling the indications of the signal is enclosed in a cast-iron box about 9 ft. 9 in. high, and 10 in. square, mounted on a concrete base between the tracks. In the bottom of the box are the air cylinders and the electro-pneumatic valves which control the admission of air to them. The distant signal is below the home signal, in accordance with standard practice. For each of the two signals, the home and the distant, a bull's-eye lens of white glass is mounted in the front of the case and behind it are two 4-c.p. incandescent lamps connected in parallel and both lighted so that the light will be maintained even if one is out of order. The color indication is given by colored glasses mounted in slides or frames which are counterweighted and are pushed up between the lamp and the lens by rods from the air cylinders below. The color indications in the signals are: red for stop, green for proceed, and yellow for caution. Immediately below the lenses are white circular discs with small black semaphore arms on their faces which remain horizontal if the signal is at danger or caution and stand at an angle of 60 deg. when the signal is cleared. This gives the motorman a visual signal indication if the lamps are not burning and is a check on his color sense. The case has doors, front and back, for the ready inspection and repair of the mechanism inside.



Automatic Block Signal and Train Stop in the Subway.

Back of each signal box and mounted on the columns supporting the roof of the tunnel is the auxiliary apparatus, which is enclosed in separate boxes. The alternating current mains are carried along on the columns near the roof and these are tapped by the connections to the transformer before mentioned, which is mounted near the top of the column. Immediately below this is the box containing the "grid" resistance for preventing the short-circuiting of the alternating current relay which is enclosed in a separate box, with the choke coil. At the bottom of the post is the valve for the automatic stop. Current for operating the electro-pneumatic valves in the signals and interlocking plants is furnished from 16 sets of storage batteries situated at certain interlocking towers in the subway which are charged by small d.c. motor generators. These batteries are arranged in pairs so that one is being charged while the other is being discharged and they furnish current at 16 volts.

The dwarf signals used at interlocking plants in the tunnel are substantially the same in their construction as the block signals except that they show only one indication on each post. The posts are 3 ft. 4½ in. high and are capped with a sphere instead of a pointed cone as are the block signals. Red and green, for stop and proceed, are the only two colors shown. These signals, like those for fast movements, have an indicator dial. Where the movement of trains is always in one direction, the dwarf signals are replaced by dummy signals of similar external appearance, but showing a fixed purple light and having the disk below the lens painted purple also.

The length of the blocks and the location of every block signal on the entire line was carefully worked out from data relating to the grades and alinement of each section. Before locating the signals an exhaustive series of brake tests was carried out by the Westinghouse Air-Brake Company, under the direction of the consulting engineer of the Interborough, to determine the distance required for stopping a train with emergency applications of the air-brake at all speeds up to 50 miles an hour. These were plotted in the form of a speed-distance chart with a curve for level track and adjusted curves for trains on 1 per cent. and 2 per cent. ascending and descending grades. From this chart the theoretical minimum distances between signals for the maximum possible speed on any gradient could be easily found, thus establishing the proper length of each overlap separately. This method was a radical departure from standard railroad practice, but one which was deemed absolutely necessary in this case. With these conditions and data to work from it was not difficult to fix the position of signals in respect to stations, curves and junctions. Suppose the stopping distance for a train running at 30 miles an hour was 400 ft. Adding 50 per cent. for safety, the minimum length of block would be 600 ft. and the length of overlap would be 1,200 ft. The minimum distance between signals is, as a matter of fact, about 820 ft. on the express tracks. The lengths of blocks have been so fixed that the maximum working capacity of the express tracks is a train every two minutes and on the local tracks a train every minute.

To prevent the occurrence of collisions as a result of disobeying the signal indications, an automatic train stop has been put in under an agreement made by the contractor with the Kinsman Block System Company, of New York. This consists essentially of a rod or shaft extending across under the rails opposite the signal post and carrying on the end nearest the third rail an arm or trip. Between the rails is a cast iron box containing an air cylinder, an electro-pneumatic controlling valve and a counterweight on the end of another arm attached to the shaft. If the signal is set at "stop" the air in the cylinder is cut off by a circuit-breaker connected with the signal blade, and the counterweight drops, throwing the stop arm to an upright position above the level of the rail. All of the cars to be run in the subway are fitted with an arm, carried on the truck, which is connected to a valve in the air-brake train pipe; and if the train runs past a signal set at stop the stop-arm, which has assumed an upright position, engages with the trip or arm carried on the truck and opens the train pipe, thereby setting the brakes on all the cars in the train and bringing it to a stop before it enters the second block ahead, in which is the obstruction by which the signal has been set to stop. In order not to delay trains unreasonably in case of derangement of the automatic stop, the trainmen are supplied with a socket key with which to turn the air valve controlling the movement of the stop-arm so as to lower it while the train is passing. The trainman must hold the valve open with the key

until after the train has passed, after which the device will resume its stop position.

The accompanying diagrams show the track circuits and the operation of the automatic train stop on a typical section of one of the express tracks. The rail Y acts as a return feed main of the power circuit and is not insulated at the ends of the block sections. The rail X is insulated at the end of each block section just beyond the signal post. The current for the track circuit is supplied through the secondary coil of the transformer which is mounted at the end of each block. Current flows at all times through the rail X, through the signal relay at the beginning of the block and back through the rail Y to the transformer. The relays have two armatures, M and N, which are normally held up. If now a train enters the block ahead of signal 1 (lower diagram), the relay at 1 is de-energized and both armatures drop. When the circuit at N is broken, the electro-magnet of the pneumatic valve controlling the home signal at 1 is de-energized and this cuts off the supply of compressed air which allows the signal to move to the stop position by gravity. The movement of the home signal blade at 1 opens a circuit breaker in the circuit controlling the distant signal at 2. This throws the distant signal at 2 to caution. At the same time that the circuit is broken at N, the circuit in the armature at M is broken and this keeps the home signal at 2 at stop. The home signal at 2 being at stop, the circuit breaker at 2 which is connected through the distant signal at 3 is held open and the distant signal at 3 is held in the caution position. The automatic train stop is connected through the armature M, and when the circuit in this armature at signal 1 is broken, the train stop at 2 is thrown up. Immediately, therefore, after a train has passed signal 1, the home at 1 comes to stop and the home and distant at 2, already at stop and caution, are continued in that position. The automatic train stop at 2 is thrown up and the distant signal at 3, already at caution, is kept so. When the train has passed out of the block beyond signal 1, the relay at 1 picks up both the armatures M and N, closing the circuit for the home signal at 2 and for the train stop at 2. These then resume the clear position and the movement of the home signal at 2 closes the circuit breaker connected with the distant at 3, throwing it also to clear. A train in any block is thus protected by a distant signal two blocks in the rear and by the home and distant signal, together with the automatic stop, one block in the rear.

The interlocking equipment is the well-known Westinghouse electro-pneumatic system with some slight modifications in the design and arrangement of the parts in the machines and switches on account of the very limited space in the tunnels. The cabin shown in one of the illustrations is only 30 in. wide and the machine has been rearranged so as to reduce the width, chiefly by changing the position of the bed-plate from a horizontal to a vertical position and changing the other parts to suit. The switches are all operated with motion plates instead of the usual bell-cranks. There are 23 interlocking machines with a total of 383 levers, situated as shown in the following table:

	No. machines.	No. levers.
City Hall	3	32
14th St.	2	16
18th St.	1	4
Spring St.	2	10
42d St.	2	15
72d St.	2	15
96th St.	2	19
100th St.	1	6
103d St.	1	6
110th St.	2	12
116th St.	2	12
Manhattan Viaduct	1	12
137th St.	2	17
145th St.	2	19
Dyckman St.	2	26
135th St.	2	6
Lenox Junction	1	7
145th St.	1	9
Lenox Yard	1	35
Westchester Ave	1	13
St. Ann's Ave.	1	24
Freeman St.	1	12
176th St.	1	56

The small machines controlling single crossovers are mounted in neat boxes on the station platforms and will not have a regular attendant. They are so arranged that they can be set and locked for clear main tracks in both directions. There are a total of 227 interlocked switches, 224 automatic train stops, 354 home signals, 187 distant signals, and 150 dwarf signals.

The compressed air for operating all of the block and interlocking signals is supplied from motor-driven compressors located in six sub-stations, one each at City Hall, 18th street, 54th street, 96th street, 143d street, and at Dyckman street and at 133d street on the Bronx division, being approximately two miles apart. Current for operating the motors is supplied from the main feed wires running from the central power plant at 59th street and Eleventh avenue. Three of the sets are sufficient to supply power for all the signals and the other three can be held in reserve for emergencies. The motor is a Westinghouse direct current machine taking 60 amperes at 600 volts and driving an Ingersoll-Sergeant, straight tandem compound, single-acting compressor through a Morse silent chain. The compressor has cylinders 19¼ in. and 12¼ in. x 12-in. stroke, and has a capacity of 239 cu. ft. of free air per minute when running at 120 r.p.m. The compressed air is transmitted from the sub-stations through 3½-in. mains which give sufficient storage capacity to the installation. An automatic rheostat and pressure regulator keeps the pressure between 80 lbs. and 90 lbs.

In connection with the signal system, there are a number of other safety devices of much interest. One of these is the emergency box, patented by Mr. Gibbs, which is located in each station, and into which all of the signal circuits adjacent to the station are led. In case of a sudden emergency, an employee or other person on the station platform can push the button in this box and immediately the signals for all tracks adjacent to the station are set to danger.

To prevent short circuits through the cars and motors when passing from one section of the third-rail to another, due to difference in voltage or grounding of one section, a balance coil relay controlling a dwarf signal in front of the break in the third-rail is introduced. When a decided difference in voltage exists between the two sections of third-rail, the signal stands at danger and continues to stand in that position until the voltage is equalized. Where the section break occurs near interlocking points, a modified arrangement is used. In this case small voltmeters are mounted over the machine. The operator can tell at a glance if the difference in pressure is great enough to be destructive, and can set the signals accordingly.

Not connected in any way, but, nevertheless, a very important adjunct to the signal system, is the installation of fire and emergency alarm signals throughout the tunnels. At every manhole on the West Side division are located a fire-alarm box and general emergency alarm box, which are connected with

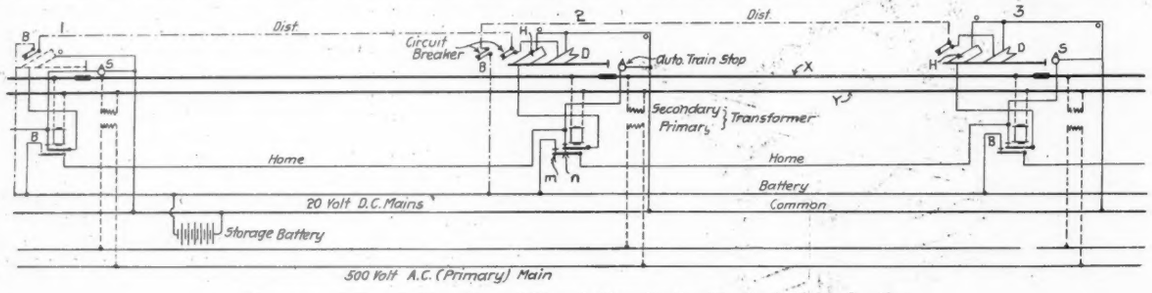


Diagram of Track Circuit and Signal Circuits for Typical Block Section.

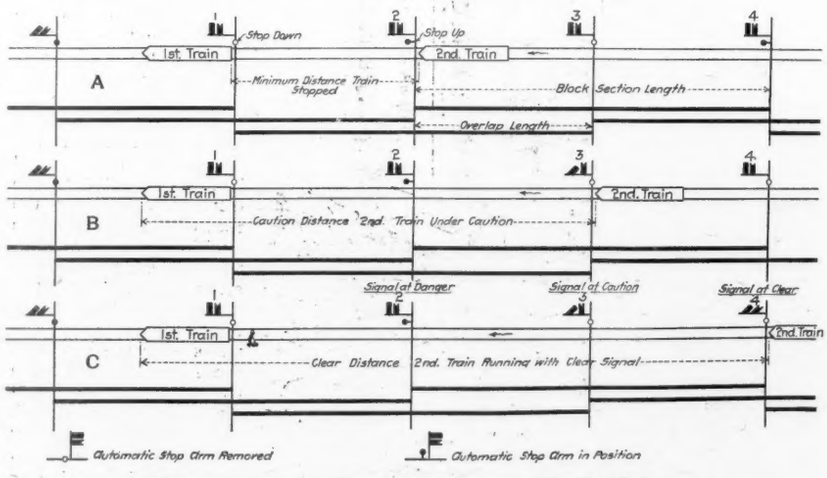
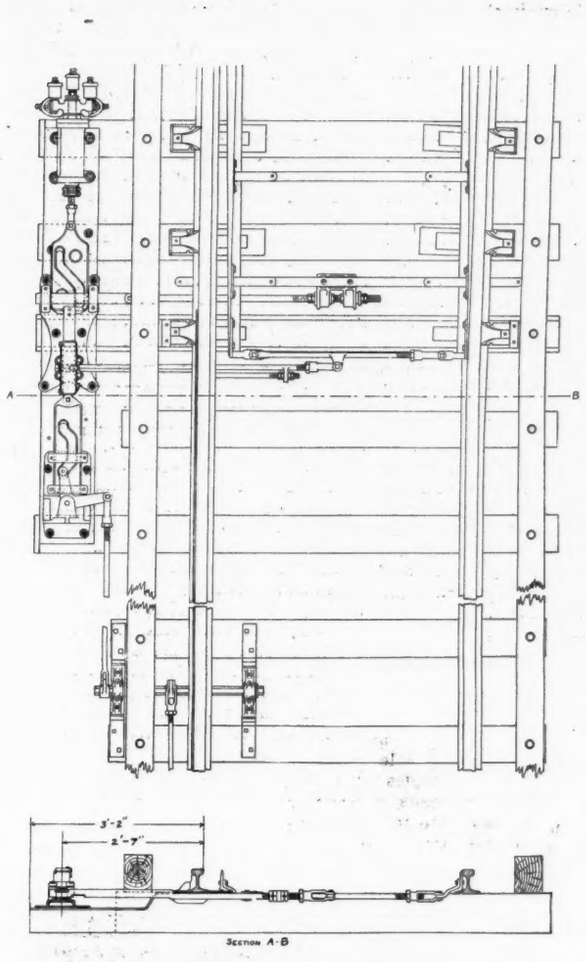
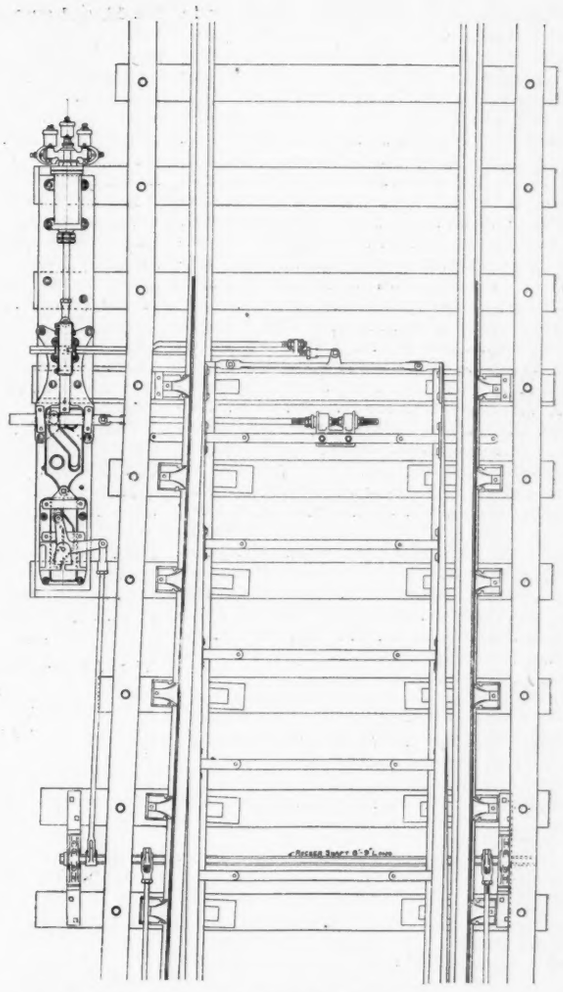


Diagram of Double Overlap Arrangement in the Subway.

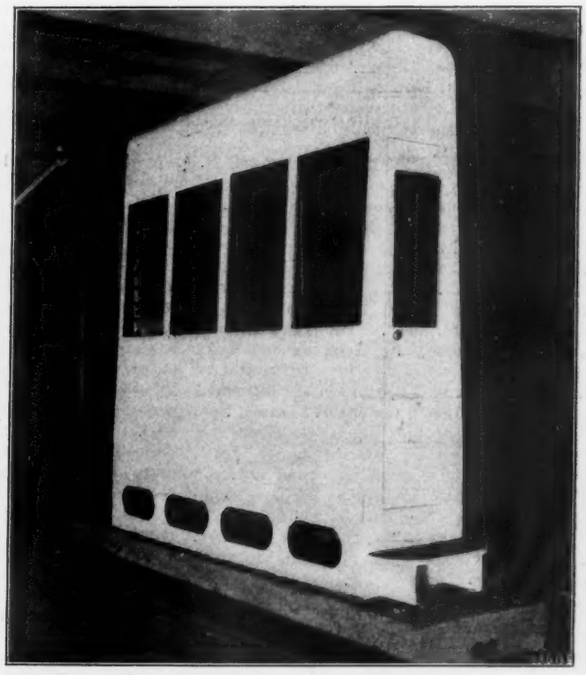


Split Switch with One Detector Bar.



Split Switch with Two Detector Bars.

Interlocking Machine at Eighteenth Street Station.



Interlocking Cabin at City Hall Station.

recording gongs in every station and also in the train despatcher's office, general superintendent's office and all of the sub-stations and power houses. In case of fire in the tunnel, the station men are instructed to pull the city fire alarm located in the passenger station which is nearest the scene of trouble, every station having one of these. The men in the electrical sub-stations, on receipt of either a fire or an emergency alarm, immediately shut off the power from the third-rail in that station so that there will be no danger to passengers walking through the tunnel. This entire alarm equipment has been furnished by the Gamewell Company.

All of the general features of the installation of the safety devices and signals on the line were worked out under the direction of Mr. George Gibbs, Consulting Engineer for the Interborough. Mr. J. M. Waldron, Signal Engineer for the road, supervised the installation. The Union Switch & Signal Company made and installed all of the apparatus under the direction of its chief engineer, Mr. J. P. Coleman, and Mr. Sidney Johnson, who had entire charge of the actual work of construction. Mr. H. M. Sperry, general agent at New York for the Union Switch & Signal Co., suggested the arrangement of the double overlaps, which is one of the most novel and important features of the installation.

All-Electric Interlocking at Oakdale, Tenn.

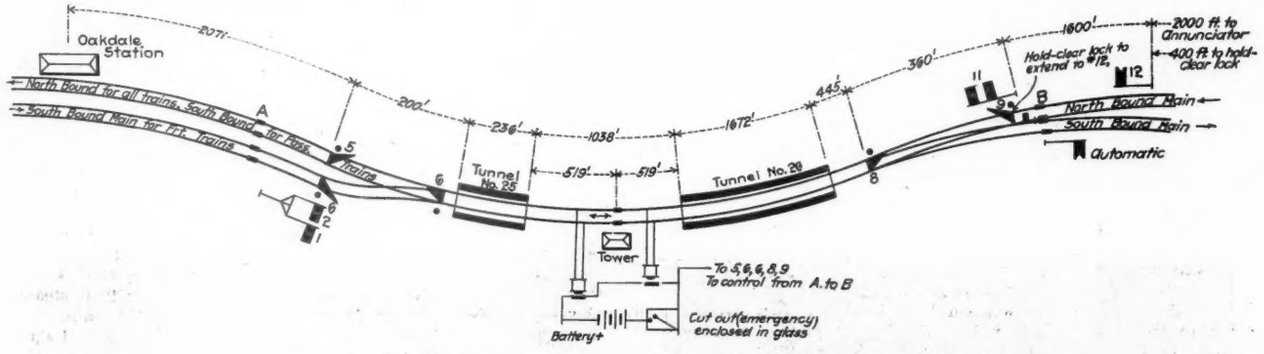
The Cincinnati, New Orleans & Texas Pacific has installed power interlocking at tunnels 25 and 26 near Oakdale, Tenn., in which one of the switches is 2,636 ft. from the cabin and one derailing switch 2,996 ft. From the north derails to the south is 3,951 ft. The apparatus is the Taylor all-electric, of the General Railway Signal Company, of Buffalo and Rochester.

A plan of the tracks embraced in this plant is given herewith. It will be observed that all of the switches and signals are out of sight of the signalman. The switches are locked automatically by track circuit locks controlled by the presence of a train at any point between A and B, and we are informed by Mr. Short, Superintendent of Signals, that trains are run through the single track section without either time-table or train orders, movements being governed entirely by the signalman by means of the semaphores. The arrangement of the relays for actuating the locks is shown in the drawing. Either track circuit, when shunted, locks the levers of derails 5, 6 and 9, and of switches 6 and 8

Signals 1, 2, 11 and 12 are slotted so as to afford immediate rear end protection. There is an electric lock on derail No. 9, which is closed by a northbound train when it reaches a point 2,000 ft. in the rear of home signal No. 12, and an automatic annunciator in the cabin is rung from a point 1,600 ft. farther south. Trains from the north are announced by the agent at Oakdale station by an electric bell. The tower is connected by telephone and bells both with this and with the first station south, and the towermen are not operators, both being cripples, having been hurt in the service of the road.

The machine is a 12-lever frame, with ten working levers; and the power is derived from a 1 K.W. generator, operated by a 2 H.P. Fairbanks-Morse gasoline engine which stands in the first story of the tower. The storage battery is 52 cells, Willard 30-ampere-hour lead accumulator. The switch and signal motors are the standard Taylor motors. There are no distant signals for southbound movements as all trains stop at Oakdale station.

The cost of this plant was about $5,500, which, we suppose, does not include the cost of the tower. While this is a low figure for apparatus performing such important functions over so large a territory, the saving in running expenses is, obviously, a still larger item, as, without perfect control of the switches at the ends of the single track section, it would be necessary to employ a night and a day attendant at each end.



Taylor Interlocking at Oakdale, Tennessee; Cincinnati, New Orleans & Texas Pacific Railway.

The Application of Electricity to Steam Railroads.*

BY BION J. ARNOLD.

The last ten years has been a period of great activity and development in the field of interurban electric railways, which has brought into extensive use the alternating current, rotary converter sub-station system of operating direct current roads. With the introduction of the suburban railway, came an increased volume of passenger travel, induced by the increased facilities which may well be noted as an example by the steam roads of what may be expected in increased revenue when frequent and pleasant service is available to the public. Those engaged in electrical industries have thus far been absorbed in fields which seem to have been naturally theirs, and their success has been such that they now aspire to enter the field occupied by the steam locomotive as a legitimate field of competition. The question is, whether this field is one in which the advantages of electricity will be sufficient to overcome the obstacles which seem almost insurmountable.

Those who have given the subject little thought or who are unable to analyze it carefully on account of the lack of the technical knowledge necessary to appreciate the difficulties to be overcome, are most apt to predict the early supremacy of the electrically driven train over the steam locomotive.

That the obstacles encountered in the development of interurban railroads have been apparently formidable yet quickly overcome is not necessarily proof or even good evidence that the legitimate field of the steam locomotive can be entered and successfully achieved. Those most familiar with the subject are now prepared to admit that our great steam railroad terminals, where many switching locomotives are shunting back and forth continuously, and those portions of the steam roads entering our great cities, where suburban trains are numerous, frequent, and comparatively light, can be more economically operated by electricity than by steam. This is evident for the reason that it simply means duplicating, on a large scale, the systems which have proven successful on street railways, operating, as they do, numerous units running at frequent intervals. Proof that this field is recognized as a legitimate one for electricity is furnished in the examples of steam railroad terminals that are now being equipped electrically, such as the lines of the New York Central and Pennsylvania in the vicinity of New York, involving an expenditure of about $70,000,000, where not only suburban service will be operated electrically, but where in the case of the New York Central, the main line trains will be brought into the city from points 30 to 40 miles distant. While these are good examples of electrical operation on steam railroads, and instances of faith on the part of the railroad managers in the ability of electricity to successfully meet the conditions of steam railroad work, where the trains are sufficiently frequent, they are by no means conclusive evidence that electrically propelled trains can be made to successfully meet the conditions of trunk line passenger and freight service which is the field now so successfully held by the steam locomotive.

The best conditions for electrical success are a great number of units moving at a practically uniform schedule, at equal intervals, within a limited distance. The steam locomotive is the most economical where there are few but heavy units moving at uneven speeds over long distances at unequal intervals and at high maximum speeds. The amount of energy transmitted to any great distance and used by electric cars on the roads that have been built up to the present time is small when compared with the amount of energy that it takes to propel a steam railroad train weighing 500 or 600 tons at the speeds ordinarily made by such trains. When investment is taken into consideration, power cannot be produced in a steam central station, under conditions that exist to-day, and transmitted any great distance to a single electrically propelled train,

*Extracts from the President's Address before the International Electrical Congress, St. Louis, Sept. 14.

requiring from 1,000 to 2,000 h.p., as cheaply as a steam locomotive, coupled directly in front of the train will produce the power necessary for its propulsion. Therefore, there must be other reasons than economy in power production, to warrant the adoption of electricity on a trunk line railroad unless it can be shown that the trains are frequent enough to make the saving in the cost of producing power greater than the increased fixed charges made necessary by the increased investment due to the adoption of electricity. There are undoubtedly in existence to-day conditions where water power in abundance is available along the right of way of existing roads, in which the substitution of electricity for steam could be made a paying one, with apparatus now available, even on roads having a comparatively infrequent service, but these are special cases and only tend to prove the correctness of the position, for in these special cases the cost of power would be but little over half the present cost of producing it by means of a central steam station.

The ideal conditions for any trunk line railroad having a traffic heavy enough to warrant the investment in a sufficient number of tracks to properly handle this traffic in such a manner as to get the most efficient service out of its rolling stock, would be to have four or more tracks between terminal points arranged in pairs upon which the trains for different classes of service could be run at uniform rates of speed. Thus, if six tracks were used, the through line, passenger and express service would be run on one pair of tracks; the local passenger, local express and local freight service upon another pair of tracks, while the through freight service would be run upon a third pair of tracks, and all the trains upon any pair of tracks would run at the same average speed and stop practically at the same places. If these conditions could prevail and the traffic were sufficient to warrant this investment in tracks, such a service could be operated more economically and more satisfactorily electrically than by steam. The difficulty is that few roads in existence have sufficient traffic to warrant such an investment in permanent way, and the result is that all of their traffic must be handled over one or two tracks, thus necessitating trains of all weights and all speeds running upon the same rails. This results in a tendency to bunch the cars into as few trains as practicable, in order not only to reduce the cost of train service to a minimum but to give the fast running trains greater headway to allow them to safely make their time. Such an arrangement of trains necessitates the concentration of large amounts of power in single units which is leading away from the ideal conditions for the application of electricity to the propulsion of trains, and it is this element, combined with the fact that the traffic on most roads is not great enough to warrant the investment necessary in electrical machinery to produce and transmit the power to the distances necessary to keep a few heavy trains in motion, that makes the trunk line railroad problem so difficult, as it is more economical to propel these heavy trains by steam driven locomotives, which are practically portable power houses.

Admitting that electricity becomes most economical when a sufficient number of trains are available, and that the steam locomotive is most economical when the trains have become few and heavy, the problem then resolves itself into one of the density of traffic, and the question then is: Where is the dividing line? No general law or formula can be laid down which will apply to all cases, for the reason that the elements entering into different cases vary so greatly that any formula would contain too many variables, dependent upon local conditions, to admit of a general application. I shall, therefore, only attempt to point out a way in which the dividing line between steam and electricity can be determined after the elements of each case are known.

It will readily be seen that with steam locomotive operation, the fixed charges, cost of fuel and engine labor increase almost directly in proportion to the increase in train miles, for in this case an additional locomotive means simply a given amount of increased investment, a given amount of increased fuel and labor, and this total investment is least when the number of locomotives is small. On the other hand, with electricity it is necessary to invest at once a large amount of capital in the power houses and transmission systems, which amount must be great enough to provide for handling the maximum number of trains required upon the line, and unless this number of trains is great enough so that the economy effected in the different methods of producing and applying the power is sufficient to offset the increased fixed charges, due to the additional invested capital, it will not pay to equip and operate electrically. Any problem, therefore, must be analyzed for the relative cost in operation. In case this does not show a saving, the advisability of equipping electrically will depend entirely upon the probable increased traffic to be derived from the adoption and operation of electrically propelled trains.

I am convinced that electricity will be generally used on our main railroad terminals, and ultimately on our main through lines for passenger and freight service, but it will not always be adopted on the grounds of economy in operation; neither will it come rapidly or through the voluntary acts of the owners of steam railroads, except in special instances. At first the terminals will be equipped for special reasons, due either to the voluntary act on the part of the Terminal Companies to effect economy in operation, or to public pressure brought to bear upon the owners through an increased demand on the part of the public for better service, on the grounds that the use of the steam locomotive is objectionable in great cities. Those roads which run through populous countries will either build new roads, or acquire, for their own protection, those electric railroads already built and operating in competition with them, and utilize them as feeders to their through line steam trains. Thus the steam railroad companies will gradually become interested in electric railways and eventually become practically the real owners of them. With these roads operating as feeders to the main line system and with the terminals thus equipped and the public educated to the advantages of riding in electrically equipped cars, the next step will logically be the electrical equipment of the trunk lines between the cities already having electrical terminals. Thus some favorably located trunk line having a sufficient density of population will feel warranted in equipping electrically, and when this is once done the other roads running between the same competing points must follow, sooner or later, in order to hold their passenger traffic. This may result in temporarily relegating some roads to freight service, so long as they operate exclusively by steam, but with the increased demand on the part of the public for better and cleaner service will come a corresponding increase in passenger revenue to the roads equipped for handling it until one road after another finds it advantageous to furnish an electric passenger service.

With the terminals and main lines equipped electrically and the desire on the part of the public for more prompt and effective freight service resembling that which is given by the steam roads in England and on the Continent, due to the great density of population, there will be developed a high class freight service conducted in light, swiftly moving electric trains which can be quickly divided and distributed over the surface tracks of the smaller cities, or through underground systems similar to that which is now being built in Chicago. Such a system would soon prove indispensable to the public and a source of great profit to the roads as it is now getting to be to many suburban railroads. This class of freight service would soon prove so large a part of the freight traffic of a road that the operation of the through freight traffic by steam locomotives, though at present cheaper, would in time, as the cost of coal increases, grow less until those roads operating an electric passenger service would ultimately use electricity exclusively.

The principal problem before the electric railway engineer to-day is how to make the most effective use of high pressure transmission, and high tension working conductors, and maintain safety of operation. Experiments conducted during the past year by engineers in this country and abroad have made this problem simpler than it seemed before and to-day we seem reasonably certain of the solution. Until recently the cost of electrically equipping a trunk line with the standard direct current rotary converter system, has been such as to practically prohibit its adoption, but recent improvements in the single-phase alternating current motor have made it possible to eliminate a large part of the investment heretofore necessary and the prospects for the application of electricity of long distance running are better than ever before. The rotary converter, which was the means of reducing the cost of long distance roads, was introduced in 1898; and within the six years from the time of its adoption through the development of the single phase, it has been practically rendered obsolete for heavy railroad work. The dividing lines between the steam locomotive and the electrically propelled train have thus moved several points nearer together, due to the reduction which can now be made in first cost and the saving in operating expenses.

With the single phase motor and the steam turbines in successful operation and the transmission problem almost solved, and with the rapid development of the internal combustion engines now taking place, we are warranted in believing that we can so combine them into a system which will ultimately supplant the steam locomotive in trunk line, passenger and freight service. The steam locomotive will hold its own in this country for many years to come, but I expect a remarkable development to soon begin in the electrical equipment of favorably located steam roads.

Tie Plates.*

A tie plate is a rolled steel plate, having thin flanges or claws on the under side, which, when embedded in a tie under the rail seat, has sufficient adhesion to cause it to act with, and become practically an integral part of, the tie. It is used for the purpose of preventing the destruction of the tie by rail abrasion, and thereby prolongs the natural life of the wood used. While this is the prime requirement of tie plates, they per-

*Report of a committee, consisting of C. E. Jones, C., B. & Q.; J. A. Kerwin, M., K. & T.; and C. F. Blue, M. & O., presented to the Roadmasters' and Maintenance-of-Way Association, St. Louis, Sept. 13, 1904.

form many other functions as a result of that just named.

There are three distinct classes or kinds of tie plates—non-adhesive, longitudinal flange and cross-grain claw. Non-adhesive plates do not come within the definition of tie plates, for the reason that they have no adhesive qualities, and therefore cannot perform the first requirement essential to a tie plate; which is, to become a part of, and act with, the tie under passing loads. They are flat-bottom plates and depend on the track spike for holding them in position under the rails. As spikes automatically accommodate themselves to the vertical wave movement of the rail, there is necessarily a space between the base of the rail and the surface of the tie in amount depending on the condition of the track, weight of rail and rolling loads; hence, a plate placed between these separately moving bodies, without inherent adhesive qualities, must be and remain loose from the time it is first applied. The abrasive movement with such a plate still takes place between the bottom of the plate and the surface of the tie, much the same as before the insertion of the plate. This was the earliest type of tie plate used, and those who remember their use will recall the black eye they gave to further experimenting with tie plates, by reason of their general ineffectiveness in meeting the requirements of a tie protecting plate.

Longitudinal flange plates were the first form of tie plate to give the necessary adhesion to the tie. There are now many plates on the market of this design, varying in detail only. These plates are rolled with deep, thin flanges on the under side, running in the direction of the plate, and when embedded in the tie, unite so firmly that they become a part of it, and prevent the tie abrasion already explained. All movement takes place between the rail and plate, metal against metal, instead as formerly, with metal against wood fiber. This form of plate is used extensively in the western and southern States, where soft wood ties are in general use. The first plates used were much too thin and too narrow. The size of a tie plate should be determined by the density of the wood on which the tie plate is to be used, and the weight of rolling stock. The size of plate depends entirely upon the compressibility of the fiber—the softer the wood the greater area the plate should have. The plate should be thick enough to resist buckling during the life of the tie at least.

The claw tie plate has a shoulder on its upper surface to abut against the outer base of the rail, and has four 1-in. claws on the under side, which are finished with a spike point, giving sharp cutting edges. These claws enter the tie with a clean cut across the grain, and give not only great adhesion to the tie, but offer effective resistance to rail spreading. These plates are used on tangents and curves, but more particularly on curves. On curves they have replaced the old, and at one time much used, rail brace. Curves of maximum degree of curvature, and having the heaviest conditions of traffic, when equipped with claw plates, are held positively to gage, and the rails are maintained in a true and natural position. In hard wood ties this is the only form of plate that can be embedded with any degree of satisfaction. Its embedment is accomplished by either driving it home, striking the plate over the claws with a hammer, or allowing the traffic to do the work.

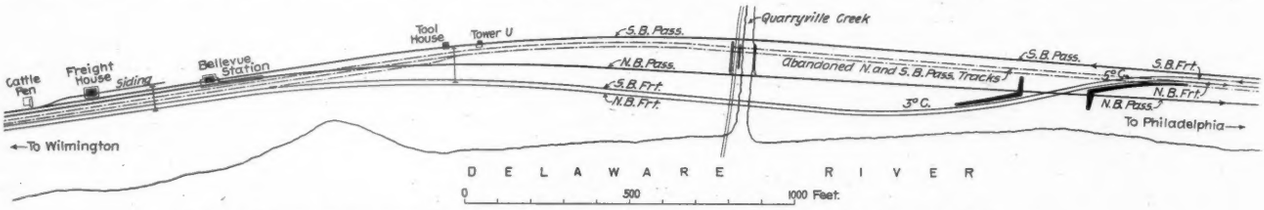
The safety to traffic from the use of tie plates is well known. Track equipped with the proper plates carefully applied, is always safe and spreading track can be made a thing of the past. It is hard to estimate the saving in cost effected by the use of tie plates, but it is large. The life of ties is extended several years because they are no longer spike killed. Adzing ties to roll the rails back into normal position is no longer necessary. Moving the section gang from one curve to another, spiking in places that seem to be more inclined to spread than to remain in proper position takes the time of the trackmen, and their time means money. Just how much this would amount to in dollars and cents over an entire railroad system would be hard to determine. However, we know that since such curves have been equipped with tie plates there is no longer such waste of labor, and consequently more time is now available for legitimate track work, which is showing from year to year in the vastly improved condition of our railroads.

Improvements on the Philadelphia, Baltimore & Washington.

The extensive track elevation work and improvements which the Pennsylvania has been carrying out on its Washington-New York line has been described from time to time in the *Railroad Gazette* within the last three or four years as sections of the work have been completed. The work between Philadelphia and New York, which includes track elevation in Newark, Elizabeth, New Brunswick and Trenton, a new stone arch bridge across the Delaware at Trenton and the entire rearrangement of the passenger terminal facilities in Philadelphia, has now been completed, but south of Philadelphia on the line of the Philadelphia, Baltimore & Washington, the work is still in progress. It includes track elevation through Chester, Pa., and Wilmington, Del.; the enlargement of the Shellpot yard at Wilmington and a new steel truss bridge across the Susquehanna river at Havre de Grace, Md., to replace the present antiquated structure.

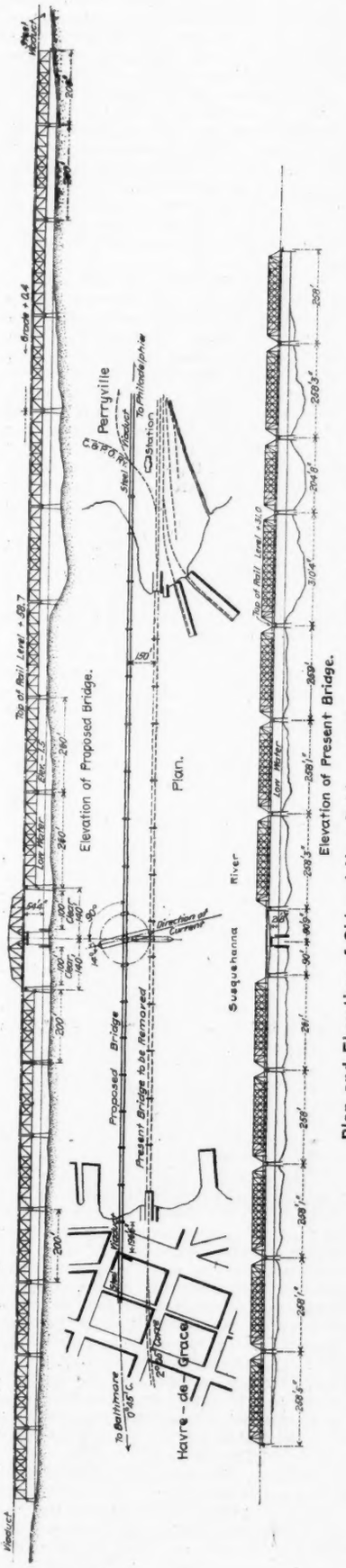
The track elevation through Chester begins at Crow creek, about two miles north of the station, and continues through Chester, Lamokin, Thurlow and Trainer, a distance of about 4.6 miles. At Lamokin the grade drops down for about 1,000 ft. to form a connection with the Central Division, which has not been elevated. The four tracks are carried on a solid fill held by broken rock range masonry retaining walls. The construction work has been carried on in the same way as the work in Newark, which was described in the *Railroad Gazette*, May 6. The wall on one side was built and a construction track carried on a trestle the height of the retaining was built. From this track the fill was dumped off to one side and when this was completed trains were diverted on to the construction track, the other retaining wall built and the fill completed. Two overhead and 27 underpass road crossings have been put in, and 14 crossings formerly at grade have been abandoned. The bridges over streets are all plate girder structures with solid floors. There has been but one change of alinement on this section of the work, at a point near Eddystone, where a 1 deg. 30 min. curve has been changed to a 50 min. curve.

About four miles south of Chester a detour has been built which is about 1½ miles long and which reduces a 3 deg. 6½ min. curve to one of 1 deg. At Bellevue, Del., eight miles south of Chester, the north and southbound freight tracks are carried under the northbound passenger track with a "jump-over," shown in plan in the accompanying drawings, and run to the east of the passenger tracks into the Shellpot yard. The grades of all four tracks have been adjusted at this point for about 6,300 ft. At the north end, the southbound passenger track begins to rise on a .25 per cent. grade, increasing to a .4 per cent. grade until it reaches a maximum elevation of 23 ft., or about 10 ft. above the old grade at that point. The station at Bellevue is located on the summit of the southbound track, which begins to fall on a .6 per cent. grade until it again reaches the old sub-grade about 1,300 ft. further south. The northbound passenger track starts from the present grade at the south end and rises with a .6 per cent. grade until it reaches an elevation of 37 ft., or 23 ft. above the level of the freight tracks which pass underneath. From there on it falls on a 1.3 per cent. grade to the old level at the north end. To make room for the fill the northbound passenger track is swung out to the east about 110 ft. away from the southbound track. The bridge over the freight tracks is 200 ft. long and is supported at each end on masonry abutments with long wing walls running back parallel to the freight tracks. The center line of the freight tracks is about 80 ft. to the east of the northbound passenger track after passing under the "jump-over," and at a point about opposite the Bellevue station they swing in again and run alongside of the passenger tracks, which also converge until the Shellpot yard is reached two miles below.



Plan of Jump-Over near Bellevue, Del., Philadelphia, Baltimore & Washington Railroad.

The track elevation through Wilmington starts at mile post 25, east of the city, and continues through to the junction of the Delaware division, about 3½ miles in all. For a part of the distance near the present passenger station the new line is deflected about 75 ft. north of the old right-of-way. This necessitates the abandonment of the old station and in its place a new and modern station and division office building will be erected. This work is similar in character to that being done at Chester and other points along the line, and includes underpasses at 25 streets. Two former grade crossings have been closed and vacated by the city. The Shellpot yard, which is just east of Wilmington, is a large old-fashioned yard operated entirely by switch engines and poling cars. It has recently



Plan and Elevation of Old and New Bridges at Havre de Grace, Md., P., B. & W.

been enlarged and changes made in the track arrangement to enable it to handle to better advantage the large volume of freight to and from the south.

At Havre de Grace an extended change in alinement will be made in connection with the new bridge which is to be built across the Susquehanna, and two sharp curves will be eliminated. The new location starts at mile post 57 in the town of Principio, and follows the old line over the river into Havre de Grace, but about 150 ft. north, joining the old line at mile post 63. The maximum curve in the new line is 45 min., whereas in the old line there are two 1 deg. curves and one of 2 deg. 5 min.

The old bridge which is to be removed consists of 12 through truss single track spans with an average length of 260 ft., and one deck swing span 181 ft. long, about in the middle of the bridge. The new bridge, which is 150 ft. upstream, will have 16 spans of deck trusses, wide enough for double track, and one through truss, swing span over the channel. The seven spans to the west of the swing span are each 200 ft. long, and the eight spans to the east of the draw will each be 260 ft. long, with one short inshore span 200 ft. long on the east bank. Steel viaduct approaches will lead on to the bridge from the embankment at both ends. The elevation of the top of rail above mean high water is 58.7 ft. on the new bridge and 31 ft. on the old bridge. This difference in level is to permit raising the tracks through Havre de Grace on an ordinary sloped bank. Four grade crossings will be carried under the tracks. At Perryville, on the east bank of the Susquehanna, a change will be made in the connection with the Columbia & Port Deposit on account of the change of grade on the new main line. Contracts for the grading of the new line have not yet been let as this work can be done any time before the completion of the bridge, which will take at least a year.

All of the improvements south of Philadelphia have been carried out under the direction of Mr. W. H. Brown, Chief Engineer of the Pennsylvania, to whom we are indebted for the drawings and information.

Locomotives and Other Rolling Stock.*

Locomotives.

The interest of French locomotive practice is centered in the development of the four-cylinder compound, which has permitted a marked increase in the weight and speed of the trains. In the majority of these engines, the high-pressure cylinders drive one axle, and the low-pressure cylinders another axle, but coupling rods have been preserved between these axles. The only exception is a unique locomotive (No. 701) built in 1885 for the Chemin de Fer du Nord, in which the two axles were not connected. This plan has not been continued. The use of coupling rods began in 1887 on the Paris, Lyons & Mediterranean locomotives. Since 1890 large numbers of such engines have been built or ordered by French railroad companies, and their aggregate number will soon exceed two thousand.

Mallet, four-cylinder engines are used on meter-gage lines. These are supported on two separate groups of coupled axles: One group, driven by the high-pressure cylinders, is connected to the locomotive frame in the ordinary way; the other group, driven by the low-pressure cylinders, forms a movable truck, so as to give great flexibility to the engine.

A few Vauclain locomotives, built in America, are in use on the State Railroads (also non-compound American locomotives on these and other railroads); and old engines have been converted into two-cylinder compounds, especially on the Midi lines. Steam pressures of from 14 to 16 kg. per sq. cm. (200 to 230 lbs. per sq. in.) are resorted to, the use of very high pressures being requisite, when it is necessary to combine power and lightness, as in locomotive engines.

The majority of the compound engines belong to two classes, which may be considered as standards in France: The express locomotive, with four large coupled wheels, of 2 m. (6 ft. 6¾ in.) diameter or a little more, and the six-coupled locomotive, with diameters of from 1.600 m. to 1.750 m. (5 ft. $2^{15}/_{16}$ in. to 5 ft. 8⅞ in.), both being fitted with a bogie in front. The six-coupled locomotives are equally fit for goods and for ordinary passenger trains. A tendency must be noticed to increase the diameter of the six-coupled wheels of these engines to about 2 m. (6 ft. 6¾ in.), for enabling them to work express trains. On the other hand, the "Atlantic" type is resorted to for increasing the power of express locomotives, the boiler, and particularly the fire-box, being enlarged.

The new "Atlantic" (Nos. 3,001-3,008), recently built for the Paris-Orléans by the Société Alsacienne de Constructions Mécaniques, is of special interest as being the most powerful express locomotive yet made for the French lines. The principal dimensions are given in Table No. 1. The adhesive weight is 36 *t** (18 *t* per axle), and it is expected that this weight will be increased to 40 *t*. Such a change is easy in locomotives of this type.

TABLE No. 1.—Principal Dimensions of "Atlantic" Locomotives of the Paris-Orleans.

Boiler:	
Internal diameter	1.513 m. (4 ft. 11½ in.)
Height, axis above rail	2.700 m. (8 ft. $10^{7}/_{16}$ in.)
Working pressure	16 kg. per sq. cm. (228 lb. per sq. in.)
Tubes:	
Length bet. plates	4.400 m. (14 ft. $5^{3}/_{16}$ in.)
External diameter	70 mm. (2¾ in.)
No. (ribbed tubes)	96
Grate area	3.1 sq. m. (33⅜ sq. ft.)
Heating surface	239.4 sq. m. (2,577 sq. ft.)
Cylinders:	
H. p. diameter	360 mm. ($14^{3}/_{16}$ in.)
Stroke	640 mm. (25⅛ in.)
Cylinders:	
L. p. diameter	600 mm. (23¾ in.)
Stroke	640 mm. (25¼ in.)
Driving wheels, diameter	**2.040 m. 6 ft. $8^{3}/_{16}$ in.)**
Weight:	
Total, working order	72,900 kg. (71.75 tons).

The following figures, extracted from the dynamometer car records and indicator cards taken during numerous runs of these engines with heavy express trains, give a fair idea of their power:

A length of 13 km. (eight miles) was traversed in 419 seconds, being at a rate of 112 km. an hour (70 miles). The cut-off was at 53 and 65 per cent. respectively, in the high and low-pressure cylinders. The mean drawbar pull, behind the tender, was 2,350 kg. (5,180 lbs.), from which results an average effective horse-power of 972†; the mean indicated horse-power was 1,830. The maximum indicated horse-power recorded on these engines was 1,900.

On the Nord, "Atlantic" locomotives, with somewhat smaller dimensions, maintain a very fine express service. Average speeds, from end to end, of 90 to 100 km. an hour (56 to 62 miles), are obtained with trains weighing (exclusive of locomotive and tender) 250 to 300 tons. The profile of the lines is generally easy, with somewhat prolonged inclines of 5 mm. per m. (1 in 200),

*Abstract of a paper by Edouard Sauvage, presented to the International Engineering Congress, St. Louis, October, 1904.

*This abbreviation *t* is used for the French "tonne."

†The unit of horse-power is here 75 kg. x 1 m. in a second, while the English unit is slightly greater. It might be advisable to express powers always in kilowatts, to do away with this cause of errors. In the present instances, the figures would be 715, 1.347 and 1.400 kw.

and, in a few places, of 8 mm. per m. (1 in 125). Some of these trains run in connection with boats from England, and, in many instances of bad weather, time lost by the boat has been made up by the train, although the schedule is calculated with a pretty fair speed.

For instance, the run from Calais to Paris (297.2 km. = 184.6 miles) has been made in 3 hr. 9 min. against a booked time of 3 hr. 30 min.; and, with a very light train, only 3 hr. 3 min. have been consumed from Paris to Calais. The run from Paris to St. Quentin (153.1 km. = 95.2 miles) has been made in 1 hr. 37 min. with a train weighing 365 *t* (359.2 English tons), and in 1 hr. 34 min. with a 300-*t* (295.2-ton) train.

The six-coupled compound of the Eastern may be mentioned as a typical express locomotive of this class. After comparative trials with "Atlantic" locomotives, these six-coupled engines have been selected as more suitable to the requirements of the lines of this system. The grate area is 2.857 m.² (30¾ sq. ft.), the heating surface, 223.94 m.² (2,410⁷/₁₆ sq. ft.); the diameters of the cylinders are 350 and 560 mm. (13¾ and 22 in.), with 660 mm. (26 in.) stroke; the diameter of the driving wheels is 2,090 m. (6 ft. 10⁵/₁₆ in.). The engine, in working order, weighs 71.8 *t* (70.66 tons), of which 51 *t* (50.19 tons) is adhesive weight.

Although in many cases the six-coupled four-cylinder compounds have replaced with advantage the old eight-coupled locomotives, which were largely used in France, the Paris, Lyons & Mediterranean system has a large number of such engines with four cylinders, and a new type of eight-coupled four-cylinder compound has been built by the Southern and by the Eastern.

In this last engine a pony truck is used in front of the cylinders. The four cylinders are placed on a line under the smoke-box. The high-pressure cylinders are inside, and drive the second coupled axle. The low-pressure cylinders are connected with the third axle. It is advisable, as far as possible, to put the low-pressure cylinders inside, under the smoke-box; but in this case their diameter was too large, and they could not be placed between the frames.

The consolidation locomotives haul trains of 800 to 900 *t* (exclusive of engine and tender) on lines with inclines of 1 cm. per m.; the same trains being taken by six-coupled engines on easy profiles. In the present state of things, the pull of these engines nearly comes up to what the car couplings can stand with safety, and could not be exceeded on that account.

Powerful tank-engines have been put in service recently, or are in course of construction, for working suburban trains, and even for general service, a rapid acceleration being of great importance in the first case. These tank-engines have six coupled wheels with a pony truck, and, in some instances, a bogie at both ends, or eight coupled wheels with one bogie in front; this last type is intended mainly for goods traffic. The four-cylinder compound system is also used for these engines.

The advantages of the four-cylinder compound system, as resulting from a prolonged practice in France, may be summed up as follows: Economy of coal resulting from the compound system in itself, or increase of power with the same consumption of coal; good utilization of steam at very high pressure, with the simple or piston valve and the old gears; good balance of pistons and other pieces with reciprocating motion; counterweights applied only for revolving parts, thus doing away with vertical variations of pressure and pounding action on rails; ample bearing surfaces for all parts of mechanism, owing to the use of four cylinders with four separate gears and suppression of all undue strains.

It must be added that these compounds possess great elasticity in working, and are as well fitted for moderate as for high speeds, for light or for heavy trains. They remain economical within a wide range of power. In the Paris-Orléans experiments, an average steam consumption of 10.5 kg. (23 lbs.) per horse-power in an hour (the power being calculated from the action exerted by the driving wheels on the rail, to compare precisely with what is called the effective power of a stationary engine) has been measured with trains of heavy and also moderate weight.

As regards details of construction, the nearly exclusive use of Serve or ribbed tubes in all new constructions is well worth mentioning. Experiments have proved that the efficiency of a given surface of Serve tubes, taking into account the whole metallic area in contact with hot gases, was about the same as with the same surface of plain tubes; and in practice, these tubes have been found durable and free from leakage. They must be kept free from ashes and soot by frequent cleaning with a steam jet and, when necessary, with scrapers.

For valve gears, the Walschaerts system has been adopted in many of the French four-cylinder compounds, as well as for ordinary locomotives. This system is quite convenient when the valve is placed above or under the cylinder, and there is a distinct advantage in the use of one eccentric instead of two, for inside as well as for outside cylinders. The whole mechanism is simple, and easily kept in order. The distribution of steam effected by the Walschaerts system is particularly good, and quite uniform on both sides of the piston at different points of cut-off.

Piston valves are used in some of the latest designs. After the experience on the Eastern, they are preferable to flat valves, chiefly as giving larger ports and so reducing wire-drawing and compression of steam. An economy of coal, as high as 10 per cent., has resulted from their use in some cases.

From prolonged experience and from the unanimity of opinion of all having experience with these engines, it may be taken for granted that the four-cylinder compound system possesses marked advantages, at least under the conditions of service prevailing on main French lines. Thanks to their use, French railroads have been enabled to increase largely the weight and the speed of their trains, for goods as well as for passenger service, without any large increase of coal consumption per kilometer run. In fact, it is rather underestimating the merits of the compounds to say that by their use the weight of trains is increased by one-third with the same cost of fuel over what it was with the best simple engines used before; or, if not the weight, speed is increased, and in many cases both weight and speed.

In other words, the compounds would take a traffic equal to four, against a traffic equal to three, the number of engines and the expenses for fuel and wages remaining the same. The initial cost of the compounds is higher, the expenses for repairs may be somewhat greater, but the increase of traffic is such that the economy is obvious. As regards the cost of repairs, there is still some doubt as to their exact amount, as a very large proportion of the compounds have been running for a few years only, but it must be remarked that the increase of expenses will very likely be due to the boilers working at a high pressure, and it seems that the same pressures would be necessary for simple engines, if they were to compete with compounds.

To this must be added, especially for passenger service, the advantages of greater speed, of more punctuality, and of dispensing in many cases with pilot engines or with supplementary trains. In a mere practical point of view, the French administrations feel satisfied with the great extension they gave to the four-cylinder compound system, from which resulted economy as well as a large improvement in their services.

A complete solution of the problem would require a proof that the same results might not be obtained in some other way. Available data are not sufficient to give such a proof in an incontestable manner; still, it seems difficult to build an ordinary locomotive quite equal in every respect to the latest compounds.

It is clear that simple two-cylinder engines might be made with the same large boiler, and work with the same high-pressure, but it is nearly as clear that, with the ordinary valve gear of the locomotive, steam at such a high pressure cannot be utilized as well as by compounding; there is little doubt that the simple locomotive would require more steam for the same work or give less work for the same quantity of steam. In addition, there is a real difficulty in making all the parts of the simple engine strong enough to stand without undue wear the great stresses resulting from the increased pressure on large pistons, although this difficulty may be overcome.

An opinion, which seems to prevail, is that compound locomotives may be economical during long runs, but that their advantage is lost when they stop and start frequently, owing to the direct admission of steam to the low-pressure cylinders at starting. This opinion is rather too dogmatic, and the question requires some consideration. In many cases, with four-cylinder compounds, the tractive power necessary for starting from rest is obtained withouut this direct admission, or steam is admitted in that way only for the very first revolution of wheels. The engine is then worked compound, but in full gear for all cylinders. Of course, steam is not so well utilized as with a proper degree of expansion in each cylinder, but, even in that case, the compound compares favorably with a simple locomotive working in full gear.

In conclusion, opinions expressed by men placed at the head of locomotive departments of French railroads will be found of interest. Among others, M. Baudry, Locomotive Superintendent of the Paris, Lyons & Mediterranean, ended a communication to the Société des Ingénieurs Civils as follows:

"Some people may be of opinion that the importance of the coal saving due to compound locomotives is small, and even vanishes when the prices of coal are very low. That is a mistake, as the saving of coal means really an increased power of the locomotive. In fact there is no saving of coal for a certain work performed, but there is more work for the same coal consumption; thence result other important savings; less locomotives, less drivers, less firemen, less trains are necessary for a given traffic. These aggregate savings, which do not depend upon the price of coal, greatly exceed, in the majority of cases, the saving of coal proper. If the weight of trains is not increased, then an acceleration in speed is possible, and in that way the construction of more economical locomotives has resulted, during the last few years, in an increase of speed on all French lines."

M. Salomon, Locomotive Superintendent of the Eastern, writes that:

"Compared to the ordinary locomotive, the compound locomotive has the important advantage of a coal economy, which varies with the nature of the service, but which is, on an average, from 10 to 15 per cent. With

the use of four cylinders the symmetry of the engine is preserved, inertia forces are in better equilibrium, the turning force is more uniform, the total work is divided between two axles, and stresses are more evenly distributed on the frame. As a consequence, the mileages between two heavy repairs in the shops has been increased by 50 per cent.

"In my opinion, the use of these locomotives marks an important improvement, which has not been accompanied by any trouble in service; the only objections which have been often made to the use of compound locomotives are want of elasticity in their power, and excessive compression of steam at high speed. As regards the first objection, the use of independent gears for the high and for the low-pressure cylinders allows a satisfactory distribution of steam under very different rates of weight and speed. The second objection vanishes with large clearances and sufficient area of steam passages on the low-pressure cylinders. In this respect piston valves will be quite suitable if they remain sufficiently tight."

Passenger Carriages.

Normal passenger carriages are of three different classes; to these must be added sleeping and saloon carriages.

All recent constructions (for main line traffic) are of the lateral-corridor type with compartments. In the best types of rolling stock, vestibules with covered gangways from carriage to carriage are used. Such is the case for first and second class coaches intended for through trains, and these are frequently carried on four-wheeled bogies. In some other cases, especially for third class, the corridor extends only inside one carriage, without communication with its neighbor; side doors are preserved, and these carriages are usually carried on two or three axles. They are all fitted with lavatories.

Sleeping cars are also of the compartment system, with two and sometimes four berths in a compartment. For suburban traffic, the old system of compartments with side doors is still used; sometimes carriages with wide platforms at both ends are preferred.

Goods Wagons.

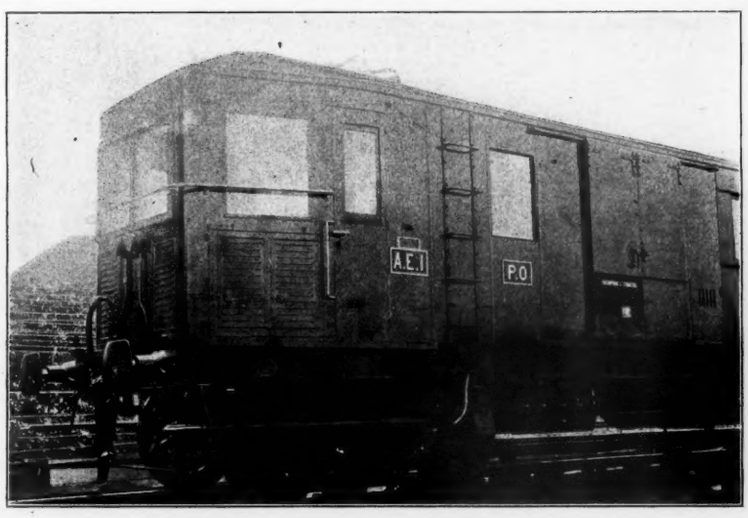
The standard wagons have two axles. The normal carrying capacity of 10 tons has been extended to 15 and even 20 tons in recent constructions. Steel bogie cars, carrying from 40 to 50 tons of coal or dense materials, such as stones or ores, have been built recently. Their use is, as yet, limited. Westinghouse brakes (and in some instances other compressed-air brakes) are used on the whole of the passenger stock and on certain goods wagons.

New Locomotives and Motor-Cars for the Paris-Orleans.

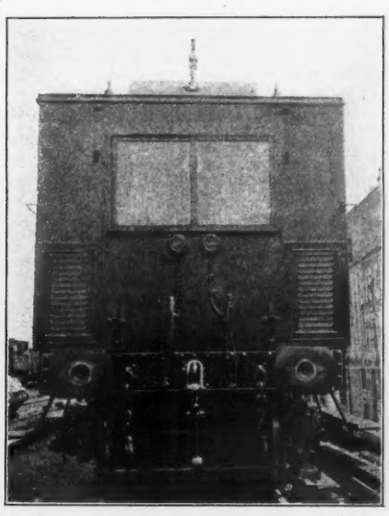
It will be remembered that the Paris-Orleans, the first French steam trunk road to make any important electric transformation of its lines, opened in May, 1900, an extension of its existing lines in Paris, creating a new terminus at Quai d'Orsay and operating the whole of the incoming and outgoing trains electrically. The generating station contains two 1,000 kw. groups, two 500 kw. substations, and two sets of storage batteries. The locomotives used were similar to the Baltimore & Ohio locomotives, having a central cab with sloping ends. Each locomotive has four GE-65 motors (225 h.p. each) and mounted on heavy trucks built by the Schenectady Works of the American Locomotive Company. The installation was made by the French Thomson-Houston Company, and the greater part of the machinery, especially the locomotives, is of American make, mostly from the General Electric Company, Schenectady.

The installation has given such satisfaction that an important extension was decided upon some time ago, and further additions have been made both to generating and substation equipment, but principally to the rolling stock. There has now been put into service, in addition to the original eight locomotives, a further lot of three, of the same powerful build, mounted on trucks similar to those on the old locomotives. The new locomotives are the baggage-car type, with a cabin at each end, and a compartment for baggage in the middle. The end cabin contains an L-7 controller and the usual circuit breaker and measuring instruments. The motor leads and the shoe-leads pass through brass flexible tubing, and connection boxes are provided for the motor leads. The motor armature coils are mica-insulated. The end cabins are lined with an Uralite insulating sheeting and the framework of the locomotive is fireproofed wood. The body is sheet steel. The gear ratio is 2.23 to 1.

The Quai d'Orsay Station of the Paris-Orleans.



New Motor Car of the Paris-Orleans.



End View—Paris-Orleans Car.

Five motor cars all equipped with the Sprague-General Electric type M control, with type C-22 controllers, have been added to the present equipment. These motor cars have a cabin at each end, and the intermediate space is taken up with a baggage compartment and a space for third-class passengers, for which 34 seats are provided. The whole of the train control apparatus is mounted in these cabins, the rheostat equipment being of course properly insulated from the contractor groups. This is somewhat a

departure from standard American practice. Similarly to the locomotives, the motor leads and the shoe-leads are passed through flexible tubing, and motor-connection boxes are used. GE-66 motors with one-turn armatures are used. The gear ratio is 3.08 to 1. The cabling used in both locomotives and motor-cars is covered with asbestos braid, slate-colored. Paint is used on the asbestos to avoid abrasion from chafing, etc.

These cars are mounted on bogie trucks of the Baldwin type. The wheel-base is 6 ft. 6 in., with 40 in. wheels. They weigh 6,250 lbs., and are calculated to carry 26,000 lbs., of which 15,000 lbs. is the weight of the empty car-body.

The following are the dimensions of the locomotives and motor cars just put into service:

	Locomotive.	Motor-car.
Length	10.2 meters.	17.3 meters.
Width	2.84 "	2.8 "
Height	3.87 "	3.8 "
Weight	55 tons.	30 tons.
Distance between centers of trucks	5.63 meters.	12.4 meters.
Wheel-base	7 ft. 10 ins.	6 ft. 6 ins.
Wheel-diameter	49 ins.	40 ins.

The service which the old and new locomotives and motor-cars will have to perform is as follows: To haul from Juvisy (a suburb of Paris) a distance of 15 miles from Quai d'Orsay terminus, to Paris and vice versa, a total of over 200 trains daily, at speeds varying from 30 to 45 miles per hour. As a rule, all trains, except those proceeding south without a stop at the terminus of the electric line, will change engines at Juvisy and proceed to Paris or to Juvisy from Paris, as the case may be, in charge of electric machines. Times for express trains will be about 25 minutes or less, including one or two stops. The all-station or local service will take from 35 to 40 minutes. For this service, the motor cars will be used exclusively. There are two trains, comprising seven or eight trailers, fitted for use with the motor cars, one of which will be at each end of the train. A half-hourly service to Juvisy is maintained, together with supplementary trains at rush hours.

All the apparatus, especially the rolling stock, is of American pattern. The motors and train control apparatus are built by the General Electric Company. In connection with this plant, it is of interest to note that the Pennsylvania is using the Quai d'Orsay terminus as a model for their new station in New York.

The French winter time-table provides for a train from Paris to Nice, 675 miles, in 13 hours and 50 minutes, which it is claimed will be the fastest long-distance train in the world.

New South Wales Government Railroads.

The annual report of the Railway Commissioners of New South Wales for the year ending June 30 last shows total receipts on the railroads of the Colony of $17,182,065 as compared with $16,574,465 for the preceding year. Operating expenses this year were $11,294,700, leaving net earnings of $5,088,000. The length of road open for traffic June 30 was 3,281 miles, an increase of 142 miles over the preceding year. The average number of miles operated during the year was 3,224. The amount of capital invested in the railroads is reported at $211,442,585, and, estimating the interest on this at $7,420,745 (the rate being 3.565, which is the average rate of interest paid on the State debt), the net earnings fall $1,533,380 short of the sum required to pay interest. The smallness of the increase in receipts is explained chiefly by the great falling off in freight traffic in consequence of the severe drought which has prevailed for two years. In spite of the adverse conditions, the percentage of working expenses to revenue has been reduced from 68.37 to 65.74.

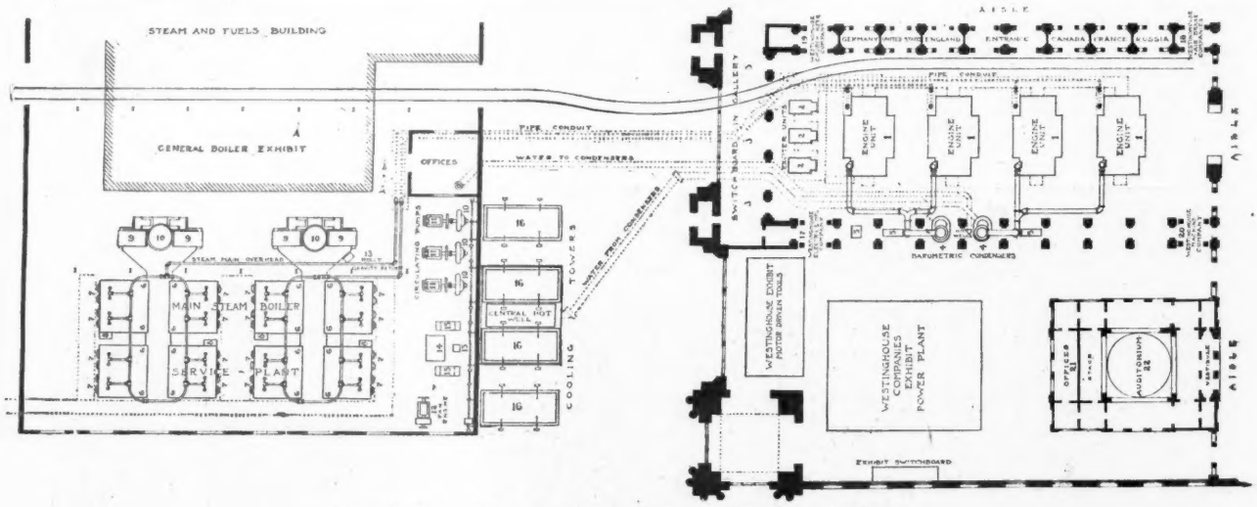
The average receipts per mile of road were $5,395 this year, as compared with $5,465 the year before; receipts per train mile $1.64 cents in 1904 and $1.43 cents in 1903. The Commissioners again call attention to the serious burden on their finances of the unprofitable railroads which have been built in the past. During the year now under review the loss on lines of this character amounted to $2,203,485, which is $333,265 greater than the loss in the year before. The people are warned that if the railroad finances are to be put into satisfactory position the construction of unprofitable lines must be suspended. There were no train accidents fatal to passengers during the year. About 240 miles of track was relaid with heavier rails and 400 miles were reballasted.

Additions to equipment included 24 freight locomotives, one passenger locomotive and 35 suburban tank locomotives; also three sleeping cars, 10 second class coaches, 66 hopper cars and six box cars.

The same report gives the statistics of the tramways of the Colony, the mileage of which on June 30 was 126. The net receipts of these lines amounted to $646,800, which was a little more than enough to pay the interest on the capital invested, calculating this at the rate above named, 3.565 per cent. In the preceding year the tramways showed a deficiency of nearly $100,000. The Commissioners are opposed to the extension of tramways except where favorable financial results are fully assured. The conversion of steam tramways to electric appears to be still unfinished, 47 steam cars, three steam motors and one cable car having been replaced by electric vehicles during the year.

The Service Power Plant at the World's Fair, St. Louis.

The main service power plant for the Louisiana Purchase Exposition is a complete central station supplying electric power for general use throughout the grounds, for the night illumination of the buildings, for pumping the water for lagoons and court basins, cascades and fountains, and for operating exhibits and concessions in various parts of the grounds. The entire steam and electric station of 14,000 h.p. capacity was designed and installed by Westinghouse, Church, Kerr & Company. The four 3,500 h.p. Westinghouse-Corliss, vertical, cross-compound, reciprocating engines in the Westinghouse enclosure at the west of Machinery Hall, the smaller engines driving exciters in Machinery Hall, the engines driving the pumps, stokers and cooling tower fans in the service plant boiler house, just west of Machinery Hall, and the Roney mechanical stokers in the latter building were built by the Westinghouse Machine Company.



General Plan of Service Power Plant, World's Fair, St. Louis.

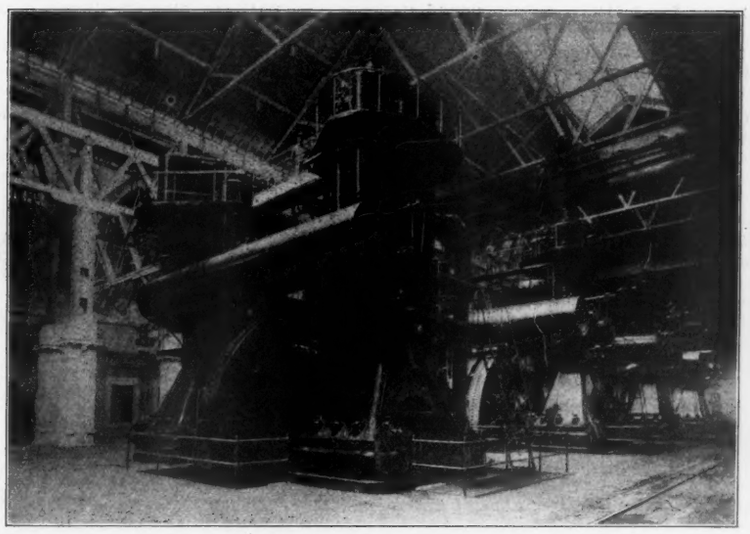
The central power station at the Chicago fair in 1893, which was also a Westinghouse installation, was of about the same total capacity as the present plant, but the 12 generators, although then the largest polyphase alternating current machines ever built, were each of only 750 k.w., or 1,000 h.p., capacity. The four 3,500 h.p. units of the Louisiana Purchase Exposition service plant, although three times as large as the largest at Chicago, are to-day regarded as of only medium size. The floor space occupied by the Westinghouse-Corliss engines and their direct connected generators is 15 ft. x 35 ft. each, being only about one-ninth of the space required at Chicago for six of the twelve 1,000 h.p. generating units which were belt driven. The plant resembles in general design such installations as the 40,000 h.p. station of the Metropolitan Street Railway Co., just completed at Kingsbridge, New York City, and the 75,000 h.p. station of the New York Edison Company, where 11 engines, rated at 6,500 h.p.

each, the largest engines in service, frequently carry a maximum load of 10,000 h.p. for short periods.

Electric current from the service plant and from exhibit power plants in Machinery Hall is transmitted at a potential of 6,600 volts, transformers being used only at distributing points. All power is controlled from the switchboard on the upper gallery over the west end of the main aisle, which has 29 panels. All main generator and feeder switches are installed in independent fireproof vaults, and are electrically operated from the main panel, indicators showing whether a switch is open or closed.

The four main units are alike in capacity and general design. The engines are of the vertical, "cross-compound" type, and run at a speed of 85 revolutions a minute. The main shaft is 3 ft. in diameter at the center and is forged hollow from open hearth steel, fluid compressed to insure homogeneity. On account of the length of the shaft the bearings are made self-alineing, having spherical instead of cylindrical seats. Both the bearing shells and the cross-head guides are arranged for water cooling.

The valve gear, which is a modified Corliss type, permits a maximum cut-off of three-quarter stroke, enabling each engine to sustain for short periods a load of 5,000 h.p. The speed of each unit is controlled by an enclosed type self-oiling centrifugal governor, adjustable while running for spring tension and sensitiveness. In order to operate the generators in multiple, a small motor is provided at the engine, which moves an adjustable weight on the governor mechanism. This motor is controlled from the switchboard, so that the engine speed may be adjusted until the incoming generator has been synchronized and connected to the system. An automatic speed limit is provided on the engines, which closes the throttle should the safe speed be exceeded because of a failure of the governor mechanism. This safety device may also be operated by the engineer from the main floor by means of an electric switch.

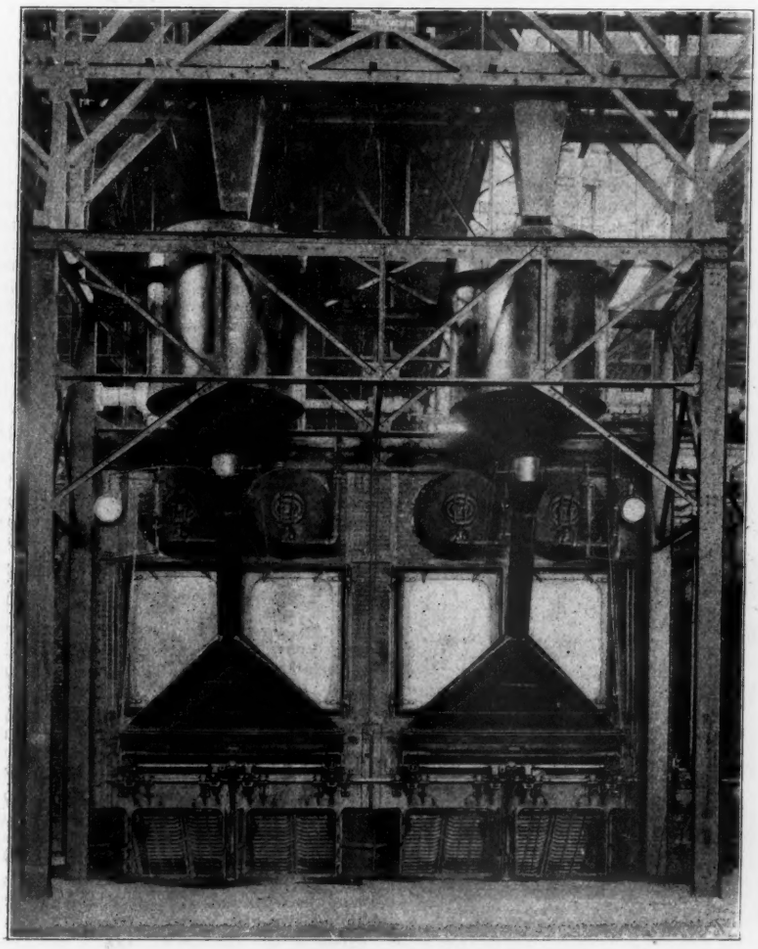


3,500-H. P. Westinghouse Units in Machinery Hall.

The generators, which are rated at 2,000 kilowatts at the usual temperature rise, are of the engine type, revolving field construction, with laminated armatures and fields. The armatures are strap wound in partially closed slots, and the fields are wound with copper strap on edge. In order to obtain access to the winding the entire generator frame may be moved out of position parallel to the shaft. Three 80 k.w., 125 volt, Westinghouse engine type units furnish exciting current for the generator fields.

All main and exciter engines, as well as auxiliaries in Machinery Hall, operate condensing, two complete central condensing equipments being installed, each of 7,000 h.p. capacity and serving one-half of the plant. They are of the Worthington elevated jet or "barometric" type, provided with entrainers and rotative "dry air" pumps for removing air from the condenser cones. Both horizontal and vertical types of pumps are in operation, one of the three being held in reserve. In case of loss of vacuum an automatic relief valve allows the exhaust steam from the engine to escape through the roof. A motor-driven valve operated from the floor below by a switch, controls the steam inlet to each condenser. Circulating water is supplied to the condensers by a centrifugal pump of the Worthington turbine pattern, direct driven by a Westinghouse compound engine. The hot water discharged into the condenser hot wells is not thrown away, but is cooled for further use in four specially designed cooling towers adjacent to the boiler room. A second turbine circulating pump elevates the hot water into the towers and, in falling, the temperature is reduced by evaporation, which process is further aided by forced draft from the fans located at the base of each tower and driven from the boiler room by a Westinghouse compound engine. A third turbine pump unit is held in reserve and may be employed on either condensers or cooling towers. Motor driven valves operated by a switch from the floor control the outlet of each pump.

Two complete systems of steam mains, 12 in. in diameter, convey steam to the main engines. The mains are carried beneath the floor in pipe galleries, anchored firmly to prevent creeping, and supported upon rollers to allow for expansion and contraction. Entrained water collecting in the boiler room piping is drained out and automatically returned to the boilers by a steam loop and "Holly" gravity return. A similar system



Boiler Eattery in Boiler House Showing Roney Stokers.

of piping for the boiler room and pumping auxiliaries is connected to the boilers between the drums and main valves, so that steam is always available at the boiler house auxiliaries. These smaller engines operate non-condensing, exhausting into two Cochrane open feed-water heaters which reclaim the greater part of the heat from the exhaust. In the engine room all auxiliaries operate condensing upon the main condensing system.

Steam is furnished by 16 400 h.p., Babcock & Wilcox water-tube boilers of the forged header type, two boilers being set in a battery. The tubes and drums are carried by steel frames independent of the brick setting. Two 10-in. loop steam mains, each connecting four batteries of boilers, deliver steam to the two 12-in. mains which carry the steam to the main units in Machinery Hall. Each group of four batteries of boilers is served by an independent induced mechanical draft equipment consisting of two fans, each capable of operating the boilers at their full capacity. A damper, by means of which either fan may be cut in or out of service, is so arranged that, if desired, both fans may be run simultaneously.

The firing of the boiler plant is done by Roney mechanical stokers, each group of four stokers in line being driven by a small Westinghouse standard engine, through suitable gearing. The stoker has a narrow rocking grate, stepped at the proper angle to give a uniform descent of fuel from the coking arch at the top to the dumping gate at the bottom. Careful observations of the smoke from the stoker chimneys are made at intervals during the day's run, for purposes of comparative record.

The Niles electric traveling crane over the main engine units in Machinery Hall is of 40-tons carrying capacity and has a span of 80 ft. It is equipped with three Westinghouse motors—one, of 20 h.p., to drive the bridge, being located at about the center of the girder, one of 20 h.p. for hoisting, and one of 5 h.p. for moving the trolley, being secured to the trolley itself. The motors are controlled from the crane cab, and current at 110 volts is supplied from the exciters for the main engine units.

Railroad Shop Tools.

(*Continued.*)

RADIAL DRILLS.

The principle advantages of the radial drilling machine are the ease with which the tool can be moved to the various parts of the work to be drilled, and also the wide range of adjustment of the drill. This latter feature in many cases enables all of the holes in a piece of work to be drilled with but one setting on the table or bedplate. The accompanying illustration, Fig. 1, shows a new 5-ft. arm radial drill made by the American Tool Works Company, Cincinnati, Ohio. The feeding mechanism of this machine is in the head and it provides for eight distinct rates of feed ranging from .007 in. to .063 in. per rev. of the spindle, any of which may be obtained by simply turning the dial shown on the feed box until the desired feed, indexed thereon, comes opposite the fixed pointer. This method is an extremely simple one, as it requires no reference to index plates and subsequent handling of levers.

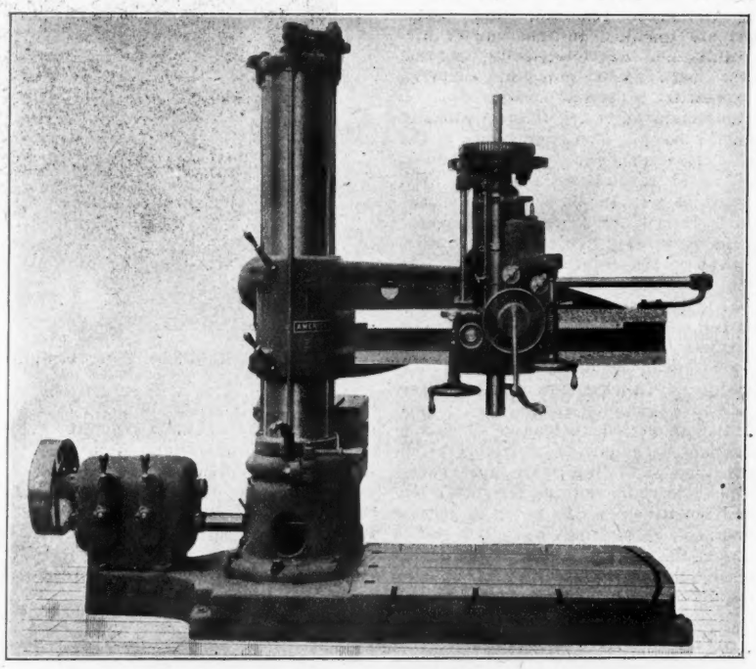


Fig. 1—The American Radial Drill.

The feeds operate through a friction which prevents the drill being crowded to such an extent that it might strain the feed mechanism. A plate attached to the machine gives a table indicating the proper feeds to be used with twist drills of all sizes from ½ in. to 3½ in., inclusive. The feeds can be automatically tripped at any position of the spindle by an adjustable trip dog and pointer acting on the worm clutch. Two or more dogs can be supplied, making it possible to counterbore any number of holes without resetting. The spindle is graduated to indicate the depth, giving all readings from zero. The trip acts automatically at the full depth of the spindle, thus preventing the breaking of the feed mechanism.

The speed box is of the geared friction type, providing four changes of speed, each being available by use of the two levers shown. The frictions are of the patent double band form and consist of few parts. When desired the speed box can be replaced by a cone by disconnecting at the coupling on the lower driving shaft of the machine. The spindle has 16 changes of speed, any one of which may be thrown in without stopping the machine. The column is of the double tubular type. The inner column extends the entire height of the outer column and provides a bearing for it at both top and bottom. This gives the equivalent of the double column and affords exceptional rigidity. The swinging arm is of parabolic beam and tube section. The lower side is parallel with the base, and the guides are extended so that holes can be drilled close up to the column. The arm is raised and lowered rapidly by a double thread, coarse pitch screw mounted on ball bearings and controlled by a convenient lever. Back gears are located on the head, thus making the greatest speed reduction at the spindle. They may be engaged or disengaged without shock or jar

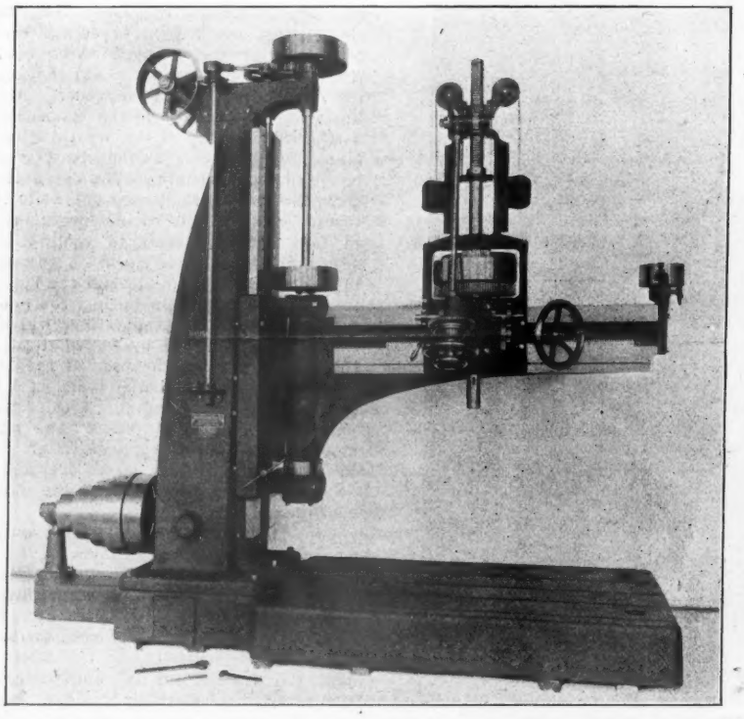


Fig. 2—The Baush Radial Drill.

while the machine is running. The drill spindle is counterbalanced and has a frictional quick advance and return. A tapping mechanism is carried on the head between the back gears and speed box where its frictions have the benefit of the back gear reduction, making it possible to perform unusually heavy tapping work. It also permits the taps to be backed at an accelerated speed. A lever for starting, stopping or reversing the spindle is controlled at the head from the front of the machine. The table has a top surface 20 in. x 20 in., and also side surfaces, which serve the purpose of an angle plate.

Fig. 2 shows a 5-ft. arm, belt-driven radial drill made by the Baush Machine Tool Company, Springfield, Mass. The tool will drill to the center of 146 in. The extreme height of the machine with arm and spindle up is 14 ft. 6 in. The bed is 146 in. long by 48 in. wide, and is 10 in. thick. The greatest distance from the spindle to the bed is 90 in., and from the spindle to the floor is 100 in. The maximum distance from the center of the spindle to the face of the post is 73 in., and the minimum distance is 27¾ in.

The arm is supported on roller and ball bearings, thus making it easy to swing around. It is provided with a friction binder for clamping it in any position. The spindle is made of tool steel and its largest diameter is $2^{15}/_{16}$ in. The spindle is counterbalanced and has a quick return motion and an adjustment of 18 in. The machine has six changes of feed which can be used with any of the spindle speeds which are provided. The countershaft is arranged for tapping, friction pulleys being furnished. This drill is made both in the belt and geared type.

A third machine, Fig. 3, is a 4-ft. radial drill made by the Mueller Machine Tool Company, Cincinnati, Ohio. The column of this machine is 9 in. in diameter and made in one piece, being bolted to the table. The arm is of pipe section and is supported on a top cap resting on roller bearings. A bronze plate is attached to the arm on which are given the correct speeds for drilling either cast-iron or steel. A ring graduated to 360 deg. turns with the arm, and in connection with a zero on the column provides a means for bringing the arm back to a definite position as often as desired.

The head can be locked to the arm in any desired position and it is adjusted by means of a double pitch screw which engages with a revolving dial on the outer end of the arm. This permits the operator to bring the head to within .001 of an in. of the required position. The spindle is made of crucible steel and is counterbalanced; it has quick advance and return and is provided with means for taking up wear. When used for tapping an adjustable gage screw causes the spindle to slip when the tap reaches the bottom of the hole, thus preventing the breaking of taps. The spindle has 16 changes of speed ranging from 18 to 370 r.p.m. The starting lever is within easy reach of the operator and controls the raising and lowering of the arm and the starting, stopping and reversing of the spindle. The automatic feed is driven by a friction plate and any feed from zero to .023 in. per revolution of the spindle can be obtained instantly and while the drill is at work.

A safety stop is attached to the automatic trip which prevents the feeding of the spindle after it has reached the limit of its travel. The dimensions of the machine are as follows:

Drills to the center of a circle on table	8 ft.
Drills to the center of a circle on base	7 ft. 8 in.
Horizontal range of head	3 ft. 5 in.
Vertical range of arm	2 ft. 9 in.
Receives under spindle over base	4 ft. 9 in.
Receives under spindle over floor	5 ft. 2 in.
Least distance between column and spindle	7½ in.
Traverse of spindle	12 in.
Extreme height of drill	8 ft.
Extreme height of spindle at greatest elevation	8 ft. 7 in.
Size of table (plain or swiveling)	15 x 25 in.
Size of base working surface	31 x 48 in.
Floor space required	96x120 in.
Weight of machine	4,100 lbs.

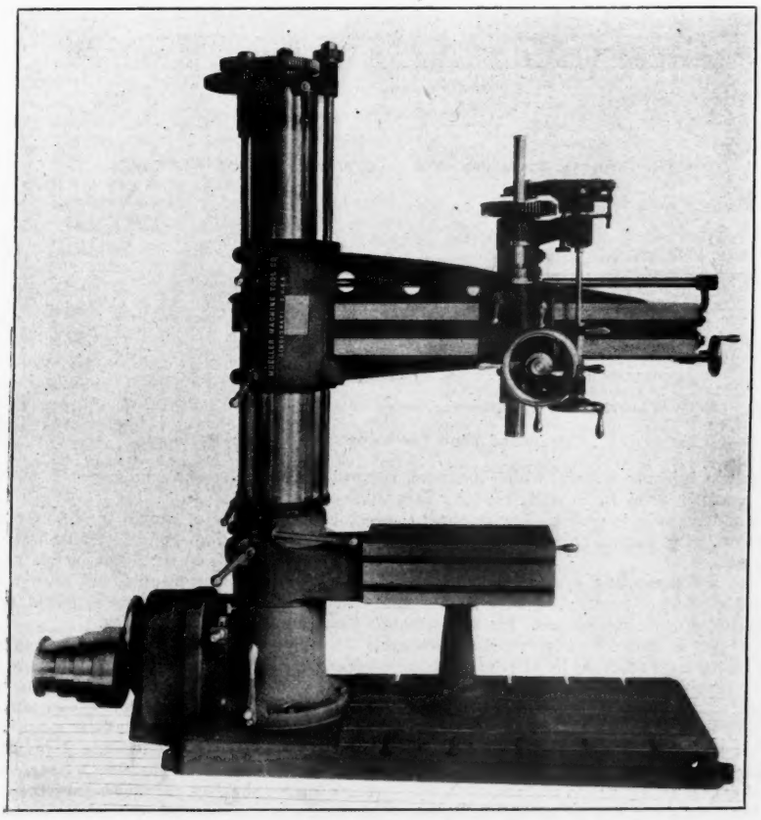


Fig. 3—The Mueller Radial Drill.

(To be continued.)

Ventilation of Tunnels.*

BY FRANCIS FOX, M. INST. C. E.

It is desirable to ascertain, if possible, the standard of purity to be aimed at in ventilating:

1.—Tunnels worked by steam locomotives, in which the products of combustion of fuel constitute by far the largest source of impurity.

2.—Tunnels worked by electricity, in which the chief source of contamination is the human lung.

The general consensus of opinion is, that in tunnels worked by steam locomotives, provided the proportion of carbon dioxide (CO_2) does not exceed 20 parts in 10,000, no harm will be done, especially as the period during which passengers are exposed to this is but short.

The consumption of fuel in the fire-box of the locomotive depends upon the heating quality of the coal, the design of the fire-box, the load hauled, and the steepness of the gradient, etc.; consequently, it is impossible to lay down any definite and accurate rule. Each tunnel must be dealt with on its own merits, and the consumption of fuel per train-mile ascertained. Instances have been quoted where this has varied from 32 lbs. per mile up to as much as 268 lbs. in the case of a steep tunnel in Japan.

Allowing 29 cu. ft. of poisonous gas for each pound of coal consumed, the volume of fresh air required to maintain the atmosphere of the tunnel at the above-mentioned standard of purity is ascertained as follows: The number of pounds of fuel consumed per mile, multiplied by 29, multiplied by 500 (that is 20 parts in 10,000) and divided by the number of minutes interval between the trains, will give the volume of air in cubic feet which must be introduced into the tunnel per minute, either by blowing in fresh, or by exhausting the foul air, to keep it in a sufficiently pure state to avoid inconvenience.

As an illustration—assume a tunnel to be one mile long, a train passing through on the up and also on the down road every 10 minutes, the consumption of fuel being 40 lbs. per train-mile, the volume of air required per minute will be:

$$\frac{40 \text{ lb.} \times 29 \text{ cu. ft.} \times 500}{5 \text{ minutes (interval)}} = 116{,}000 \text{ cu. ft.}$$

The greatest disadvantages due to bad ventilation, are injury to employees, inconvenience to the passengers, danger of accident, slippery condition and rapid oxidation of the rails. On August 11, 1898, in the long tunnel of Ponte Decimo near Genoa, which is on a 2½ per cent. grade, a train which, in consequence of the greasiness of the rails, came to a stand (the men on the engine being rendered unconscious) ran back down the incline on the wrong road, and collided with a passenger train waiting its turn to pass through. The result was that 12 persons were killed and 40 injured; all the result of bad air.

The loss of weight in steel rails is also very serious, amounting in the case of the Box tunnel of the Great Western Railway to 2½ lbs. per yd. of rail per annum, as compared with ¼ lb. on the open-air portion of the railroad.

For tunnels worked by electricity, a different method of calculation must be adopted. No vitiation by combustion of fuel has to be provided for, but, on the other hand, the antiseptic properties of certain constituents

*Extracts from a paper read before the International Engineering Congress, at St. Louis, Oct. 6.

of coal, which are doubtless of value, are wanting.

Air which has been partially vitiated may not be very excessive in CO_2, nor give very bad results from a bacteriological point of view, yet it is very objectionable and injurious, producing languor and headache, and, if inhaled for too long a period, may cause the contraction of disease; but in crowded assemblies where it has been breathed, rebreathed, and breathed again, it is most pernicious.

The extent to which CO_2 may be added to pure air, without any very serious results for a short period, is remarkable; as high a proportion as 160 parts in 10,000 has been experimented with without injury, but, in combination with the products of respiration of a crowded audience, even 20 parts is excessive; it can only be regarded as an index of the toxic condition of the air. After long investigations by English and French chemists, the volume of air required by each person per minute has been fixed at 30 cu. ft.

Assuming that the standard of purity:

(1) for steam-worked tunnels, should be 20 parts in 10,000 of CO_2,

(2) for electrically-worked tunnels, 30 cu. ft. of air per minute per passenger,

the next step is to consider the best methods for effecting the desired results.

Two of the earliest instances of ventilated tunnels are those of:

a.—The Severn tunnel under the River Severn, on the main line to South Wales of the Great Western Railway.

b.—Of the Mersey Railway under the River Mersey, between Liverpool and Birkenhead.

The Severn Tunnel is 4 miles, 624 yds. long, the gradient varying between 1 in 90, and 1 in 100, and has one ventilating shaft, placed as near the middle as the river would allow, or 1 mile, 1,210 yds. from the southern entrance, being thus 862 yds. from the center. This is, of course, not an ideal position, as in certain directions of wind, the ventilating fan (which is a Guibal, 40 ft. in diameter with blades 12 ft. wide) is liable to draw its air mainly from one direction. In time as the traffic increases, a modification of this arrangement will have to be effected. The volume of air ejected from the tunnel by this fan is 400,000 cu. ft. per minute.

The Mersey Tunnel was a much more complicated problem to solve, owing to there being three underground stations to be provided for. The plan at the outset was to allow fresh air to enter at the stations, so that the platforms should be kept fresh and pure. Consequently the vitiated air was drawn from points midway between the stations. By this arrangement, fresh air flowed into the tunnel at the stations, by means of the footways, staircases and lift shafts; it then traveled along the tunnel, getting more and more foul as it proceeded, until it reached the part of the tunnel equi-distant between stations, by which time it attained its maximum of impurity, when it was swept down, by the drag of the fans, into the ventilation headings, and ejected into the open air at the fan chamber. So long as these fans were kept running at their stipulated speed, and good coal was used on the locomotives, the ventilation results were excellent; but later, in consequence of financial difficulties, both these were modified, without improving the condition of the atmosphere. As, however, the tunnel is now worked electrically, the volume of air required is much reduced.

Table 2 gives the sizes and outputs of each fan. That at Hamilton street was found occasionally, when under a strong southwesterly gale, to be "drowned" in fresh air, consequently it had to be connected by drift with Hamilton Square Station, so as to be available when required to assist the other fans.

RESULTS OF EXPERIMENTS WITH VENTILATING FANS AT THE MERSEY TUNNEL.

Fan at	In feet. Diameter of fan.	In feet. Width of blade.	No. of revolutions per min.	Area of drift-way.	Water gage, in in.	Velocity of air, in ft. per min.	Volume of air, in cu. ft. per min.
Hamilton St., Birkenhead...	30	10	47	113 sq. ft.	1.30	1,895	214,135
Shore Road, Birkenhead....	40	12	45	41 "	2.50	3,288	134,685
James St., Liverpool	40	12	45	72 "	2.45	2,465	178,880
James St., Liverpool.....	30	10	60	60 "	2.30	2,062	123,720
Bold St., Liverpool	12	5	240-300	No. drift-way.*	....	.....	300,000
Total							951,420

*Air being drawn direct from the underground station.

The proper ventilation of electric tube railways similar to those in London is an especially difficult problem. These lines consist of parallel tunnels, each containing a single track, and at certain points these two tunnels merge into one to provide for cross-overs and switches. In addition to these places, there are, at the stations, numerous passages connecting the two tunnels, and consequently a well-regulated current of air traveling in a given direction cannot be secured. The train passing in one direction in one tube pushes the foul air at A, in front of it to the cross-over opening where it is sucked in behind the train B moving in the opposite direction in the other tube. Thus the air is simply churned round and round, and very little of the foul air is actually discharged or fresh air brought in. If fresh air is forced down from the surface through one shaft there is a tendency for it to ascend through an adjacent shaft. If, however, the well-known Saccardo injector system, which has been so successfully used in ventilating long steam railroad tunnels, is combined with shaft ventilation, very satisfactory results can be obtained.

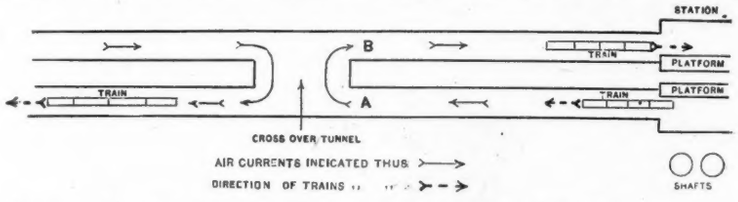
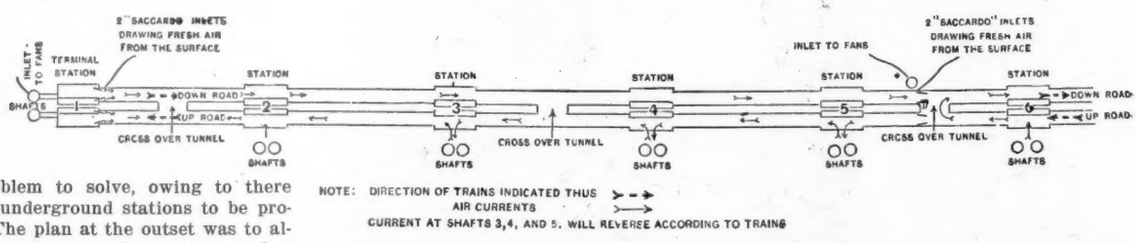


Diagram Showing Direction of Air Currents in Tube Railways.



Proposed Plan for Ventilating Tube Railways.

The accompanying diagram shows a proposed method of ventilating with such a combination of the two systems. The direction of the trains is shown by the dotted arrows and that of the air currents by full arrows; cross-over tunnels do not exist at most of the stations.

The direction of the air currents is to a great extent regulated by that of the trains, which fit the tube with but little clearance, and consequently act as pistons.

Starting from the terminal, Station 1, the first object is to keep the air at the platforms fresh, and this can be done by drawing air in from the outside by Saccardo fans, as shown, at the further end of platforms. Fresh air is drawn down the shafts at Station 2, by the suction of the trains, and this is returned along the parallel tunnel towards 2 and 3 by the combined effect of the trains and fans.

The air in shafts 3 and 4 will to a great extent be controlled by the piston action of the trains. The current will be constantly reversed, and this cannot be avoided unless the Saccardo system be more frequently introduced; this, however, is unnecessary, but at No. 5 it is again employed, and the same result for the next two or three stations will be repeated.

For every 100,000 cu. ft. of fresh air which is blown into the tunnel, or drawn in by the trains, an equivalent amount is ejected; the result being that, although this arrangement is far from ideal or perfect, it will maintain the air in a very fair condition.

As to the volume of air required, the following is the principle by which it is ascertained.

Assume holiday traffic, when the road is crowded to the maximum degree, trains running every 2½ minutes in each direction, that is 24 trains each way, or 48 in all, each train loaded to its full capacity, of say, 600 passengers, and traveling at a speed, including stops, of 18 miles per hour, three stations per mile, and each platform crowded with passengers.

For each mile of single tunnel, there will pass through in an hour 24 trains, each with 600 passengers, and requiring 30 cu. ft. of air per passenger per minute, but each train is on the one-mile length for a period of only $^{60}/_{18}$ minutes $= 3\frac{1}{3}$ minutes.

Therefore, for each tube, for each mile, the quantity of air required per minute is 69,000 cu. ft. When the trains and platforms are less crowded and the traffic assumes its normal volume the quantity of air required can be proportionately reduced. Arrangements should be made for the free passage of vitiated air from the carriages into the tunnel, otherwise the congested condition of the air on arriving at the terminus will be aggravated.

GENERAL NEWS SECTION

THE SCRAP HEAP.

At Pittsburg the medical examiners of the Pennsylvania Railroad are giving lectures to the employees of the company on First Aid to the Injured.

The Philadelphia & Reading, having on hand a large surplus of steam sizes of anthracite coal, is using anthracite in some of its locomotives which ordinarily burn bituminous coal.

Once a week during this month, and longer if necessary, the Nashville, Chattanooga & St. Louis will run a sleeping car from Nashville to the St. Louis Fair for employees of the company.

Reports from Chicago are to the effect that favorable weather has now put the greater part of the corn crop out of danger of severe damage by frost, and that business and railroad men no longer indulge in pessimistic talk; there is a feeling of confidence.

The New York, New Haven & Hartford has put on a new fast mail train between New York and Boston, running through in 5 hours 30 minutes. This is half an hour longer time than is taken by the limited expresses. The eastbound train starts at 2 a.m. and the westbound at 2.30 a.m.

The White Star steamship Baltic, which arrived in New York on September 29 from Liverpool, brought 3,544 passengers, the largest cargo of human freight that ever crossed the Atlantic on one vessel. There were 412 first cabin passengers, 247 second cabin, and 2,885 steerage. The crew numbered 340, making the total number of persons on the ship 3,884.

On Monday last, October 3, a six-car train of the Interborough Rapid Transit Company, New York City, was run over the line of the new subway from Brooklyn Bridge northward to 96th street in 10 minutes 45 seconds. The distance is a little over seven miles, making the rate 40 miles an hour. No stops were made, but there is a sharp curve at Fourth avenue and 42nd street, and speed had to be reduced at one or two other places.

It is stated in a Western paper that on the Southern Pacific when a passenger presents an invalid ticket (such as are frequently sold by scalpers) he is not ejected from the train when he refuses to pay fare, but is returned to the point at which he began his journey over the Southern Pacific. It it said that this action is taken in consequence of the results of a number of lawsuits by passengers of this kind in which the railroad company has had to pay damages.

The Wabash has reduced to seven hours the time of its day express, the Banner Blue Limited, between Chicago and St. Louis. This is one hour less than the time which has been agreed on by all of the roads as the minimum. The Chicago & Eastern Illinois announces a through train between Chicago and St. Louis; time, 9 hrs. 40 min. Since the opening of this company's connection to St. Louis, it has run a through night train, but none in the daytime.

Judge Grosscup, in the United States Circuit Court at Chicago, has enjoined 19 ticket brokers from dealing in the unused portions of non-transferable round trip tickets. Most or all of the injunctions heretofore granted by the courts, on complaints like that in this case, have specified tickets for certain places or occasions, but the present order includes tickets for any and all destinations. The railroad companies named as complainants, each of which has a separate but duplicate restraining order, are the Southern Pacific, Atchison, Topeka & Santa Fe, Michigan Central, Union Pacific, Baltimore & Ohio, New York, Chicago & St. Louis, Chicago, Burlington & Quincy, Oregon Short Line, Pennsylvania, Grand Trunk Western, Chicago & Erie, and Oregon Railway & Navigation Company.

The Barge Canal.

The New York State Canal Board has approved the plans and specifications for the first six contracts under the barge canal appropriation for the new barge canal, mention of which was made in these columns last week. All that now remains is for the Superintendent of Public Works to advertise for bids, which will be accepted for the entire work or for a single section.

Interlocking.

A Taylor electric interlocking machine is to be put in at Pana, Ill., by the Baltimore & Ohio, the Chicago & Eastern Illinois, the C., C., C. & St. L. and the Illinois Central. It will be a large plant. Interlocking is to be put in at the crossing of the Missouri Pacific and the Atchison, Topeka & Santa Fe at Wichita, Kan. The Lake Shore & Michigan Southern is to put in a large interlocking plant at the new yards at Elkhart, Ind. The New York Central has put in a number of electro-gas semaphores for distant signals at mechanical interlockings.

M. C. B. Association Circular.

The committee on repairs to steel cars, which was continued for the present year for the purpose of designing and submitting at the next convention a drawing showing the manner of splicing center sills when damaged to such an extent that it required them to be cut off less than 8 in. from the bolster, has asked the members to submit drawings showing the manner of splicing center sills on steel cars; also drawings showing the manner of splicing they would recommend when center sills are damaged as described in the foregoing. Drawings should be sent to Mr. T. H. Russum, Supervisor Car Department, B. & O. R. R., Mt. Clare, Baltimore, Md., before December 31.

Railroad Y. M. C. A.

Miss Helen Miller Gould, who has made numerous liberal gifts to the Railroad Young Men's Christian Association on the Missouri Pacific and allied lines in the Southwest, is now making a tour of the principal towns on those lines, to visit the Associations. She is accompanied by Secretaries Hicks and Lougee and their wives. The party will stop at Scranton, Pa.; Peru, Ind. (Wabash); St. Louis, Denver, and many division points in Kansas, Colorado, New Mexico and Texas. At Pine Bluff, Ark., Saturday, October 15, a new railroad association building will be dedicated, and a gospel meeting will be held on the following day. At Van Buren on the following Friday another new building will be opened.

Railroad Construction Camps in the West.

In railroad building, as in most enterprises of the day, new methods are being adopted, imagination is giving way to mathematics. In the construction camps that spring up along the surveyed route of a modern railroad, the dance halls, the liquor saloons, and the gambling shacks that once were so characteristic are no longer tolerated. The construction crews of 1865 swaggered and sang and worked with fierce, if spasmodic, energy, whereas the railroad builders of to-day are going soberly about their work, drawing pay for six days of effort each week, and spending a short hour about the sleeping tent lantern, after dark, singing college songs and concocting innocent jokes.

Graduates of our great technical and engineering schools have taken up the work of building our frontier railroads. A good theoretical knowledge of surveying and a pair of strong football shoulders are more valuable assets than the ability to hold one's own against the camp bully and to shoot straight against an Indian attack. This change in the camp personnel has largely destroyed the romance of the business, but it has greatly increased the effectiveness and permanency of the work. It is more profitable to lay a permanent roadbed and take advantage of every chance for a short way through while the grades are first being made, than to build long tunnels and cut-offs at great expense years after the line has been completed. Patience and science are required to put through the newer roads, and the trained engineers, with their sober, trained assistants, who understand how to take advantage of the newest tools, are the men who are doing the work.

The railroad builder of to-day lays his camp out with every care for sanitation; the cots are comfortable and are placed inside log shanties or well pitched tents that shelter the sleepers; the food furnished is better than that served in the ordinary country hotel; and the man who brings liquor into the camp has short shrift there. The men, after the day is over, bathe in the lake and the rivers. Some of them spend odd half hours fishing. In camps in Montana, recently visited, the rule that drinking and gambling should not be tolerated was enforced rigidly. The conditions were made as pleasant as possible under a régime that called for frequent changes of location.

The charm of the railroad camps lies in meeting the sort of men that work there. They are of the salt of the earth.

Another camp, presided over by a western university football player, was found to be a sober, early-to-bed-early-to-rise establishment where men slept ten hours and worked ten. After a satisfactory supper there was an hour of magazine reading, singing, or joking that reminded one of a two weeks' excursion into the Adirondacks with congenial campers. . . .—*New York Evening Post.*

A Peruvian Work Train.

The accompanying illustration from a photograph taken on the line of the Cerro de Pasco Railroad of Peru, shows a gang of "cholos," or native laborers, on their return from work. The photograph shows 600 men who having finished a day's work of ballasting, are loaded on fifteen 30-ft. flat cars for the trip to camp. It is said that in the progress of the work, there were occasions when the passengers on this construction train were even more numerous than they appear in the view, for whenever the work was more than five miles from

A Peruvian Work Train.

camp, there was no return for dinner. On such occasions, the trips at the beginning and end of the day were attended by large numbers of women carrying supplies of food, earthen vessels and peat for fuel, who occupied themselves during the morning in preparing the noon-day meal for the men.

The Cerro de Pasco Railroad connects La Oroya with the copper and silver mines of Cerro de Pasco, 83 miles to the north. Its entire length is at an elevation exceeding 12,000 ft. The cars of the train shown in the photograph were made by the American Car & Foundry Company, and the locomotive was built at the Rhode Island Works of the American Locomotive Company. The photograph was taken by J. H. Maysilles, a representative of the American Locomotive Company, a graduate of Purdue University, and for the time in question, the engineer of the train.

A Trans-Continental Wheat Movement.

A press despatch from Duluth says that 3,000,000 bushels of wheat has been engaged in the State of Washington to be shipped to Lake Superior, and it is added that some of it will go down the Lakes. What price is paid for the transportation of wheat over this long journey is not stated, but a newspaper item printed in St. Louis seems to indicate that some Washington wheat is being sent there also, the rate being given at 52½ cents per 100 lbs. The distance from Spokane to Duluth is about 1,500 miles. A rate equal to one half cent per ton per mile for this distance would add 22½ cents a bushel to the cost of wheat. During the past few months the price of wheat at Duluth and other milling centers in the Mississippi valley has been high, while on the Pacific Coast it has been normal; a temporary condition which probably will soon end.

Specifications for Cars for the Isthmian Canal Commission.

The Isthmian Canal Commission has advertised for bids for 1,000 dump cars and 500 standard American flat cars. Proposals must reach the office of the Commission in Washington not later than 12 o'clock noon on October 20. The specifications call for proposals to furnish the cars either set up on the track at Colon, Isthmus of Panama, with freight charges from New York to Colon paid by the Canal Commission, or set up on the track at Colon with freight and all expenses to be paid by the builder; the bidder to name two prices covering both cases for each type of car bid on.

Dump Cars.—One thousand of these cars will be required and delivery must be made at the rate of at least 200 cars per month during the months of January, February, March, April and May, 1905. The cars are to be made entirely of steel or other acceptable metal and must dump all the load on either side of the track as required, or one-half on either side of the track. While center dumping is desirable it is not absolutely essential. All cars must be free dumping and cars dumped by air, operated from the engine or caboose, will be preferred. Other things being equal, preference will be given to cars of the greatest capacity with the greatest range of positions in dumping, and which can be operated and maintained with the least number of men at the lowest expense.

The capacity of the cars is to be not less than 20 cu. yds. or more than 40 cu. yds. of loose material. The cars must be strong and substantial, as the loading will be principally broken rock, dumped from steam shovels with dippers of 5 cu. yds. capacity. The following points are desired: (a) Durability; (b) largest possible capacity; (c) widest range of facilities for free dumping; (d) lowest possible height above the rail level. All bids must be accompanied by detailed drawings and manufacturers specifications; also by a list of cars of the same character furnished other parties with a certified record of the work actually done by them. No bids will be considered for any type of car which has not actually had service tests. Bids will be considered for cars of the gondola type to be unloaded by Lidgerwood or other power unloaders.

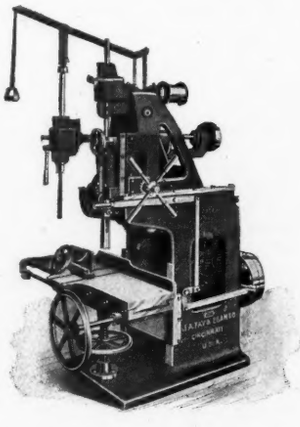
The trucks are to be of arch-bar type with 62-in. wheel base, metal bolster and 33-in. M. C. B. wheels. Gage of cars is to be 5 ft. and the journals, axles and trucks should be so constructed as to admit of afterwards pressing the wheels into a 4 ft. 8½ in. gage, should it be desired to change the gage at any time.

Flat Cars.—There are to be 500 standard American 80,000-lb. flat cars, built entirely of steel or other acceptable metal, the only wood used being all-heart yellow pine in the floor. Delivery is to be made at Colon at the rate of 100 cars a month, commencing November 1, 1904. Trucks to be of the arch-bar type with 62-in. wheel base, metal body and truck bolsters and 33-in. M. C. B. wheels, the type of truck to be such as to give a reasonable amount of flexibility. All castings in the construction must be malleable iron wherever practicable to be used. No bids will be considered for any type of car not having had actual service tests. All parts of cars must conform to M. C. B. standard specifications and the cars must be equipped with air-brakes and automatic couplers, with hand brakes, using a folding brake shaft, located on the corner of the car.

The cars are to be 5 ft. gage, 35 ft. long over end sills, 8 ft. wide over side sills, 34½ in. from rail to center of drawbar, and height from rail to top of floor to be the lowest possible, using M. C. B. standard sizes for all parts. The same provision should be made for changing gage as is specified for the dump cars.

A New Mortiser.

The accompanying illustration shows a new design of hollow chisel mortiser made by the J. A. Fay & Egan Company, Cincinnati, Ohio. It is intended for railroad and street railway car shops, and is designed for chisels up to 1½ in. square. The main column is cast in one piece, with broad floor base, giving steadiness and freedom from jar or vibration. The upper part is carried on friction rollers, and is easy of adjustment for mortises out of line. The pilot wheel for moving the upper column travels back and forth with it, retaining it at all times in a convenient position for the operator. Stops are provided for the transverse movement of the upper column, which is 11 in. The chisel ram is mounted in a dovetail slide and has a stroke of 6 in. It is counterweighted, making it easy of adjustment, and can be quickly set to the different depths of mortise desired or to compensate for different thicknesses of material. The boring spindle in the chisel is driven by



miter gears, which permits of belting it from above or directly below the center of the machine.

The feed mechanism is contained in the lower column and gives two speeds to the chisel. The chisel has a return stroke of 3 to 1 accomplished by means of elliptical gears. The feed is controlled by a lever within convenient reach of the operator, and is arranged to stop the chisel instantly at any point of its stroke. The table, which is 12 in. x 48 in., is mounted on the lower column and forms a take-up for all wear. It is raised and lowered 12 in. by means of screws, has a lateral movement of 18 in. by means of a rack and pinion, and has stops for gaging the length of mortise. It will accommodate material 17 in. high and 12 in. thick. An adjustable clamp is provided for holding any thickness of mortise, and goes clear to the fence. The auxiliary boring attachments are placed on one, or on each,

side of the frame at such a distance from the chisel as will permit of adjusting them to an angle of 30 deg. in either direction. These are convenient for joint-bolt boring, and save much handling of material. The depth of stroke of these boring attachments is 12 in. and the transverse movement is 11 in.

Historical Sketch of Power Interlocking.

In the Bulletin of the International Railway Congress for August (Volume 18, No. 8,) the editor, Mr. L. Weissenbruch, gives a 127-page description of the all-electric switch and signal apparatus recently installed at the Central Station in Antwerp, Belgium. The substance of the paper has been read before the Engineers' Association of the schools of the Ghent University, and also before the Belgian Society of Electricians. Mr. Weissenbruch is the well-known secretary of the International Railway Congress and is "Chief Engineer, Signal Superintendent" of the Belgian State Railroad. The description of the switches and signals, motors, batteries and appurtenances is full and detailed and is accompanied by over 100 illustrations. As a preface to the description, the author gives interesting notes concerning the early experiments in power operation of switches and signals. The hydraulic apparatus of Bianchi & Servettaz is named first; this was put in use in Italy in 1886. The Westinghouse pneumatic, without electrical connections, was first put in use at Bound Brook, N. J., in 1884. Bound Brook, by the way, is situated on the Southern Pacific, if we may believe the writer of this article. The subsequent experiments with the Westinghouse apparatus, culminating in the electro-pneumatic of the present day, are briefly noticed. Electro-pneumatic plants are now in use on the Great Eastern, the Lancashire & Yorkshire and the North Eastern railroads of England; on the Eastern of France, and at two places in Germany. A machine of 97 levers has lately been put in at Cottbus on the Prussian State Railroads. The all-air apparatus of the Pneumatic Railway Signal Company is noticed, and the author next takes up the all-electric. He says that switches and signals were worked by electricity on the Northern of France in 1888. The Ramsey-Weir apparatus was put in use at Cincinnati in 1891. Siemens & Halske put up electric interlocking on the Austrian State Railroads in 1893, and there are now 85 cabins with 4,258 levers (including spare spaces) where this firm's electric apparatus is in use. These 85 plants are in Germany, Austria, Russia, Denmark and Belgium. The author then notices the Taylor system, the Crewe (Webb and Thompson), the apparatus of Sykes and that of Ducousso & Rodary, the latter being in use in France. Sykes' is a recent installation at St. Enoch's, Glasgow.

Manufacturing and Business.

The Eureka Iron Co., of Newark, has been incorporated in New Jersey with a capital of $250,000 by Eddy L. Clark, Harry Tevers and J. Edward Smith.

The Protectus Co., of Philadelphia, Pa., announces that Luther Martin, Jr., Vice-President, has terminated his official relations with the company.

The Missouri Valley Bridge Co., reports say, has bought ground and will rebuild its works at Leavenworth, Kan., which were recently destroyed by fire.

Bids are wanted October 11 by Captain T. B. Lamoreau at Fort Ethan Allen, Vt., for building a 150,000-gallon steel tank and trestle at that place.

The Caspar Engineering Co., of Newark, has been incorporated in New Jersey with a capital of $500,000 by Frederick J. Stegmaier, H. J. Schultz and C. H. Caspar.

The Fairchild & Olney Machine Co., of Olney, Ill., has been incorporated at Dover, Del., with a capital of $300,000, to build and operate power railroads and rapid transit lines.

The Sheridan Smelting Co., of Camden, has been incorporated in New Jersey with a capital of $750,000 to make iron and steel, by Samuel B. Scott, H. S. Ambler, Jr., and H. B. Lewis.

J. R. Wemlinger, of the Cambria Steel Co., formerly Engineer, has been appointed Assistant to the New York Sales Agent of the Gautier Department of the company at 71 Broadway.

The Steam Engineering Co. has been incorporated in New York with a capital of $100,000 to make and deal in steam generators. The directors are: J. N. Huston, W. H. Grey and O. D. Davis, of New York.

The Detroit Graphite Manufacturing Company has removed its St. Louis office to suite 1,110, Missouri Trust Building. The new quarters are larger, and are better facilitated for handling the increased business of the company.

At the annual meeting of the stockholders of the American Steel Foundries Co. in Jersey City October 4, P. K. Neidlinghouse was elected a director to take the place of S. R. Callaway, deceased. The other members of the board were re-elected.

The Directors of the Locomotive Appliance Company, of St. Louis, have elected the following officers: Ira C. Hubbell, President; Willis C. Squire, Clarence H. Howard, J. J. McCarthy, Vice-Presidents; J. B. Allfree, Consulting Engineer; E. B. Lathrop, Treasurer; W. H. England, Secretary.

The Northern Engineering Works, Detroit, Mich., reports the following sales of electric and hand cranes: U. S. Light House Board, Detroit, two 6-ton; Van Dorn Iron Works, Cleveland, one 15-ton electric; Proximity Mfg. Co., Greensboro, N. C., one 20-ton; and others to Warren, Pa., Midland, Mich., and other cities.

At the Holyoke convention of the New England Water Works Association September 14, the Deane Steam Pump Co. made an interesting exhibit of meters, including the well-known Worthington duplex meter and disk hot-water and oil meters. This company has recently introduced the use of meters for measuring compressed air.

The Standard Roller Bearing Co., of Philadelphia, it is reported, will soon be in the market for a large amount of machinery, to include some screw machines, 20 drill presses, 15 lathes with a swing of from 14 to 30 in., 15 Universal grinding machines, three milling machines and one power machine. S. S. Eveland is Manager.

The Allis-Chalmers Company has lately strengthened the forces in its commercial department by the addition of a dozen men: all men of experience and well-known in the business and manufacturing world. In the New York office Charles F. Adae, S. H. Sharpsteen and G. Fred Collins are salesmen and special representatives; in the Pittsburg office Wilbur M. Ruth has been appointed salesman and engineer and R. L. Richardson salesman. John F. Burke represents the company at Omaha. At Chicago W. M. S. Miller has joined the staff of the Allis-Chalmers Company and John V. Redfield that of the Allis-Chalmers-Bullock Company. The Allis-Chalmers Company has also secured the services of James Ashworth, O. C. Ross, Charles S. Buell and M. C. Miller.

Iron and Steel.

At four of the Carnegie Steel Co.'s open-hearth furnaces, Sharon, Pa., work has been resumed after a shut-down of two months, and 500 additional men will be employed.

One of the most modern furnaces in the United States has just been successfully blown in at Buffalo by the Buffalo & Susquehanna Iron Company. Its annual output will be about 225,000 tons. This furnace is the second of the large furnaces to be located at Buffalo, the first one belonging to the Lackawanna Steel Company.

The Lake Superior Corporation produced 600 tons of rails recently in one day at its Sault Ste. Marie works, which is about 100 tons in excess of the former capacity. One of the new pig iron blast furnaces will be in operation shortly and the other in about two weeks. Their combined capacity will be 400 tons a day. The company proposes to build another furnace to produce all the pig iron necessary for the operation of its own works. The contracts in hand, which include one for 10,000 tons of rails for the Intercolonial Railroad, will keep the rail mill running at full capacity until about June of next year. An additional contract for all the rails that may be needed on the Intercolonial for relaying purposes during 1905 will probably be awarded to this company, which will bring the amount up to about 35,000 tons.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies see advertising page 30.)

Southern Railroad Commissioners.

The next convention of this association will be held at St. Louis, Mo., October 25, 26 and 27. N. W. Baptist, of Nashville, Tenn., President.

Canadian Railway Club.

At the monthly meeting of this club in Montreal October 4, the discussion of the paper on "Boiler Design" carried over from the last meeting was continued, and a new paper on "Fire Protection" by T. McHattie, Master Mechanic, Grand Trunk Railway, was read.

American Association of General Passenger and Ticket Agents.

At the 49th convention of this association to be held at Fortress Monroe, Va., October 18, reports will be received from auxiliary associations as follows: From the American Association of General Baggage Agents, Canadian Ticket Agents' Association, American Association of Traveling Passenger Agents, and the International Association of Ticket Agents. The new subjects for discussion include a paper on "The Abolishment of Sunday Excursions by All Lines." The annual address will be delivered by S. H. Hardwick (Southern Railway).

Iron and Steel Institute.

At the American meeting of this association to be held in New York October 24 and 26, the following papers will be presented: "Iron and Steel at the St. Louis Exposition," by Professor H. Bauerman, Member of the International Jury; "A West African Smelting House," by C. V. Bellamy, M. Inst. C. E., Director of Public Works, Lagos, with an appendix by F. W. Harbord, Assoc. R. S. M., F. I. C.; "The Influence of Carbon and Phosphorus Upon the Strength of Iron and Steel," by H. H. Campbell (Steelton, Pa.); "The Rateau Low-Pressure Turbine at Steelworks

and Collieries," by E. Demenge (Paris); "A Dry Air Blast Apparatus," by James Gayley, President of the American Institute of Mining Engineers (New York); "High-Speed Tool-Steels," by J. M. Gledhill, Member of Council (Manchester); "The Determination of Carbon and Phosphorus in Steel," by Baron H. Jüptner von Jonstorff (Vienna), Andrew A. Blair (Philadelphia), Gunnar Dillner (Stockholm), and J. E. Stead, F. R. S., Member of Council (Middlesbrough); "Acid Open Hearth Manipulation," by Andrew McWilliam, Assoc. R. S. M., and W. H. Hatfield (Sheffield); "A Power Gas Plant for Johannesburg," by P. J. Mallmann, M. A. (London). The headquarters will be at the Hotel Astor, 44th street and Broadway.

PERSONAL.

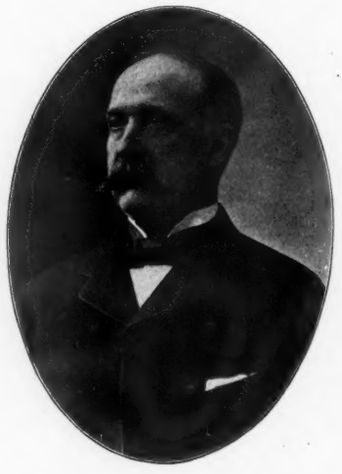
—Mr. C. D. Pettis, Supervisor of the car department of the St. Louis & San Francisco, was born in Paducah, Ky., in 1870, and was educated at the Chickering Institute at Cincinnati, Ohio. Mr. Pettis began work in 1887, at the Lafayette Car Works. Later he went to the Terre Haute Car Company as draughtsman. He then became Superintendent of the Elliott Car Company at Gadsden, Ala., and in 1893, was put in charge of the car department of the Southern Railway at Washington, D. C. For two years from 1895, he was assistant in the mechanical and car departments of the Swift Refrigerator Transportation Company at Chicago, and from 1897 down to the present time he has been General Foreman of the Car Department for the Illinois Central.

—Mr. W. B. Poland, Superintendent of the Indiana Division of the Baltimore & Ohio Southwestern, has resigned; and is to take charge of the construction and operation of the Alaska Central Railroad, which is projected to extend from Cape Resurrection north about 450 miles to the Yukon River. Mr. Poland is a graduate of the Massachusetts Institute of Technology. His railroad work began on the Cleveland, Cincinnati, Chicago & St. Louis, where he had charge of surveys and maintenance for a number of years. In 1898 he was appointed Engineer in charge of grade reduction on the Mississippi Division of the Baltimore & Ohio Southwestern. He was subsequently appointed Division Engineer of the Baltimore & Ohio at Pittsburg, and later Superintendent of the Baltimore & Ohio Southwestern at Cincinnati.

—Mr. Charles S. Clarke, whose appointment as Vice-President in charge of operations of the Missouri Pacific is announced, is 42 years old, and was born at Frederick, Md. His father, James C. Clarke, was at one time President of the Illinois Central, and later President and General Manager of the Mobile & Ohio. Mr. Clarke was educated in New Orleans and entered railroad service in 1879 as a machinist's apprentice on the Illinois Central at Chicago. Subsequently he became Master Mechanic on the Chicago and Middle Divisions and the Havana & Rantoul Divisions. From 1890 to 1899, he was Division Superintendent on the Mobile & Ohio. He was next made General Superintendent of the M. & O. When the Southern interests obtained control of the Mobile & Ohio, Mr. Clarke was promoted to be General Manager of the latter line, with headquarters in St. Louis, which position he now leaves to go to the Missouri Pacific.

—Mr. Alvah W. Hall, formerly of the Hall Signal Company, and one of the best known signal men in the country, died suddenly at his apartments in New York city on Sept. 27, at the age of 52. Mr. Hall, with his brother, William P. Hall, was in the automatic signal business from boyhood, his father, Thomas S. Hall, being the originator of the well-known Hall enclosed disk signal. In the reorganization of the Hall Company about 1890, A. W. Hall was engaged in important experiments on the Boston & Albany, looking to the perfection of the signal as then designed. After a few years he severed his connection with the Hall Signal Company, and in 1900 he went to Buffalo, N. Y., and was the principal promoter of the Taylor Signal Company. For the last year or two he has lived in Switzerland most of the time, and his wife arrived in New York from Europe only a few days before his death. He had been in poor health for several months, but had improved somewhat, and, with characteristic energy, was making plans for a new business enterprise up to within a few days of his death.

—Mr. James Edmund Childs, General Manager, who has been elected a Vice-President of the New York, Ontario & Western, has been connected with the company for many years. Mr. Childs was born at Neversink, N. Y., in 1848, and has been in railroad service 39 years. He began on the New York & Oswego Midland, now a part of the "O W,"



in 1865, as Assistant Engineer. Later he held a similar position on the Chicago & Michigan Lake Shore. In 1870 he was Resident Engineer for the Buffalo, New York & Philadelphia, and the following year worked in the engineering department of the Rochester & State Line. In 1872 he was on the Wisconsin Central as a Division Engineer. For two years from 1873 he was Assistant Engineer on the New York & Harlem, but in 1876 returned to the Rochester & State Line as Chief Engineer and Superintendent, and five years later went to the New York, Ontario & Western as General Superintendent. In 1886 Mr. Childs was promoted to be General Manager, and now receives in addition the well-earned title of Vice-President.

Mr. John McGregor Adams, President of the Adams & Westlake Company, died at Highland Park, Ill., on Saturday, Sept. 17, at the age of 71. Mr. Adams was the founder of this well known concern and was one of the best known veterans in the railroad supply trade.

—Mr. L. F. Loree, the head of the Rock Island System, with numerous titles (which the reader will find in the column of Elections and Appointments) has resigned. This announcement, published in the daily papers as we go to press, was a great surprise to the railroad world. It came as a result of meetings of the directors of the Rock Island and the St. Louis & San Francisco at Chicago on Tuesday, and undoubtedly indicates sharp dissensions among the different parties now active in the two boards of directors. Mr. Loree had been on the Rock Island only nine months, having left the Presidency of the Baltimore & Ohio to take up the undoubtedly difficult task of consolidating the divergent and territorially widespread interests of the newly agglomerated systems of the Rock Island and the St. Louis & San Francisco. This short period has, of course, scarcely sufficed for a beginning. The difference between this undertaking and the position that Mr. Loree gave up is in some degree suggested by the statement, published in the newspapers and generally credited, that, to get Mr. Loree, the Rock Island people contracted to pay him $75,000 yearly for five years and gave also a large cash bonus.

—Mr. Frederick Norton Finney, who has been chosen to succeed Mr. Rouse as President of the Missouri, Kansas & Texas, is a native of Boston, Mass., and is 72 years old. Mr. Finney's railroad career dates from 1854, when he began as a rodman on the Cincinnati, Harrison & Indianapolis Short Line. In 1857 he was admitted to the Bar and for a few years practiced law at Oshkosh, Wis. In 1860 he entered the service of the Chicago & North Western, and was in charge of construction for two years. Then for a time he was city engineer at Toledo. In 1864 he was made First Assistant Engineer of the Mountain Division of the Union Pacific. He then went to the Lake Shore & Michigan Southern as Resident Engineer of the Jamestown & Franklin Division, and from this company he went to the Erie & Pittsburg and became Chief Engineer. From then until 1887, Mr. Finney was on the Canada Southern as Chief Engineer and General Superintendent, the Toledo, Peoria & Warsaw as Chief Engineer and Superintendent, and the Wisconsin Central and associated lines as General Manager. In 1890 he was elected President of the Minneapolis, St. Paul & Sault Ste. Marie, and Second Vice-President of the Duluth, South Shore & Atlantic, and in 1891 President of the Wisconsin Trust Company. Mr. Finney's office will be at St. Louis.

ELECTIONS AND APPOINTMENTS.

Algoma Central & Hudson Bay.—The officers of this company are: C. D. Warren, President; W. F. Hobbie, Secretary; both with offices at Sault Ste. Marie, Ont.; A. H. Chitty, Assistant Treasurer; C. Shields, General Manager, Sault Ste. Marie, Ont.; C. A. Shields, Superintendent, with office at Michipicoten, Ont.; J. S. Wynn, General Auditor; W. H. Cowell, Purchasing Agent, and C. E. Slayton, Master Mechanic.

Atlanta & Birmingham Air Line.—J. M. Barr has been elected President.

Baltimore & Ohio Southwestern.—W. B. Poland, Superintendent of the Indiana Division at Cincinnati, has resigned to go to the Alaska Central in charge of construction and operation.

Chicago & Alton.—At a meeting of the Board of Directors held in Chicago recently, D. G. Reid, James H. Moore and Robert Mather were elected Directors, succeeding M. L. Schiff, F. S. Winston and the late C. H. Chappell.

Chicago, Cincinnati & Louisville.—D. G. Edwards, has been appointed Passenger Traffic Manager; C. A. Wilson has been appointed Chief Engineer, succeeding H. L. Jackson, resigned; G. R. Balch has been appointed Purchasing Agent, succeeding J. A. S. Graves, resigned. All with offices at Cincinnati, Ohio. A. L. Moler, hitherto Superintendent of Motive Power, has been

given the title of Master Mechanic, with office at Peru, Ind. All the above-named gentlemen, except Mr. Moler, hold similar positions on the Cincinnati, Hamilton & Dayton.

Chicago, Milwaukee & St. Paul.—F. D. Tucker, hitherto Superintendent at Aberdeen, S. Dak., has been transferred to Des Moines, Ia., succeeding B. F. Van Vliet. G. G. Mason succeeds Mr. Tucker at Aberdeen.

Chicago, Rock Island & Pacific.—L. F. Loree, Chairman of the Executive Committee, on October 4 resigned, and also resigned his place as Director of the C., R. I. & P., and of the St. Louis & San Francisco. At meetings of the two companies held in Chicago, October 4, Robert Mather was elected Chairman of the Executive Committee of the C., R. I. & P., and B. F. Yoakum Chairman of the Executive Committee of the St. L. & S. F. Mr. Loree also resigned as President and Director of the Rock Island Company of New Jersey, and Mr. Mather was elected to succeed him.

W. M. Hobbs, Assistant General Superintendent of Transportation, has been appointed General Superintendent of Transportation, succeeding C. E. McKim, resigned.

E. B. Boyd, General Freight Agent of the lines East of the Missouri, has resigned.

Cincinnati, Hamilton & Dayton.—See Chicago, Cincinnati & Louisville.

Cumberland & Pennsylvania.—H. Rittenhouse has been appointed Engineer of Maintenance of Way, with headquarters at Cumberland, Md., succeeding O. C. Deffenbaugh, previously Supervisor of Road.

Dayton, Lebanon & Cincinnati.—Theodore Stebbins has been made President and General Manager, and Frank Brandon Secretary.

Denver & Rio Grande.—W. D. Lee, hitherto General Manager of the Santa Fe Central, has been appointed Superintendent of the Fourth Division of the D. & R. G., with headquarters at Alamosa, Colo.

J. M. Walker has been appointed Superintendent of Telegraph, with office at Denver, Colo., succeeding W. B. Glardon, resigned.

Erie.—C. C. Riley, hitherto Superintendent of Car Service, has been appointed Superintendent of Transportation, with office at Jersey City, N. J., succeeding A. M. Mozier, who has been assigned to other duties. G. W. Kirtley has been appointed Assistant Superintendent of Transportation. The position formerly held by Mr. Riley has been abolished. William E. Talcott has been appointed Real Estate Agent, with office at New York City, succeeding F. A. von Moschzisker, resigned.

Grand Rapids & Indiana.—J. H. P. Hughart has been appointed General Manager; W. B. Stimson, Superintendent of the Northern Division, and E. H. Barnes, Resident Engineer. All with offices at Grand Rapids, Mich.

Houston & Texas Central.—J. A. Cottingham has been appointed Engineer of Maintenance of Way, succeeding A. V. Kellogg, and C. K. Dunlap, General Freight Agent, succeeding W. H. Taylor, assigned to other duties.

Illinois Central.—A. W. Sullivan, Assistant Second Vice-President, has resigned. (See Missouri Pacific.)

Interborough Rapid Transit Company (New York).—E. P. Bryan, Vice-President and General Manager, has been relieved of the duties of General Manager, and Frank Hedley, hitherto General Superintendent, has been appointed General Manager. The position held by Mr. Hedley has been abolished. D. W. McWilliams has been appointed Treasurer, succeeding J. F. Buck.

Jamestown, Chautauqua & Lake Erie.—H. T. Mentzer has been appointed Acting General Passenger and Freight Agent, with headquarters at Jamestown, N. Y., succeeding D. J. Bill, resigned.

Jonesboro, Lake City & Eastern.—F. C. Bryant, General Freight Agent, has resigned, effective November 1.

Missouri, Kansas & Texas.—Frederick N. Finney, President of the Wisconsin Trust Company, has been elected President of the M., K. & T., succeeding Henry C. Rouse, resigned.

Missouri Pacific.—Alexander G. Cochran, hitherto General Solicitor, has been appointed Vice-President, to be in charge of the legal affairs and general contract relations. Charles S. Clarke, hitherto General Manager of the Mobile & Ohio, has been appointed Vice-President of the M. P., to be in charge of its general operations and affairs.

A. W. Sullivan, hitherto Assistant Second Vice-President of the Illinois Central, has been appointed General Manager of the M. P., with headquarters at St. Louis.

Mobile & Ohio.—E. L. Russell, hitherto General Counsel, has been elected Vice-President, with office at Mobile, Ala. R. V. Taylor, hitherto General Auditor, has been appointed General Manager, with headquarters at St. Louis, Mo., succeeding C. S. Clarke, resigned. (See Missouri Pacific.)

National of Mexico.—H. P. Gallagher has been appointed Superintendent of Express, with headquarters at Mexico, succeeding J. M. Nixon.

New York, Ontario & Western.—J. E. Childs has been elected a Vice-President, with the title of Vice-President and General Manager. J. C. Anderson, hitherto General Freight and Passenger Agent, has been appointed Traffic Manager.

Pere Marquette.—W. D. Trump, hitherto Assistant General Superintendent, has been appointed General Superintendent, succeeding A. M. Smith, resigned. The position formerly held by Mr. Trump has been abolished.

Pullman Company.—W. H. Waite, District Superintendent at Cleveland, Ohio, has been transferred to Chicago. J. E. Hill succeeds Mr. Waite at Cleveland.

Quebec Southern.—F. D. Anthony, Chief Engineer, having resigned, T. Brennan, Roadmaster, has been placed in charge of Maintenance of Way and Bridges, with office at Sorel, Que.

Rock Island Company of New Jersey.—See Chicago, R. I. & P.

St. Louis & San Francisco.—See Chicago, R. I. & P.

San Pedro, Los Angeles & Salt Lake.—Henry Hawgood, heretofore Chief Engineer, but more recently Consulting Engineer, has resigned, and E. G. Tilton has been appointed Chief Engineer.

Santa Fe Central.—See Denver & Rio Grande.

South Georgia & West Coast.—C. I. Harrell, hitherto Acting General Freight and Passenger Agent, has been appointed General Freight and Passenger Agent.

Wheeling & Lake Erie.—J. H. Dowland, Auditor, has resigned.

LOCOMOTIVE BUILDING.

The Arkansas Southern denies being in the market for five locomotives.

The Atlanta & West Point is having two locomotives built at the Rogers Locomotive Works.

The Peabody Coal Company is having one locomotive built at the Brooks Works of the American Locomotive Co.

The Tennessee Central is reported to have ordered six consolidation locomotives from the Baldwin Locomotive Works.

The Davenport Locomotive Works have sold two 6-wheel freight locomotives to the San Juan Sugar Corporation, of Vera Cruz, Mexico. Special equipment includes: Monitor injectors, Washburn couplers, Davenport springs, Nathan sight-feed lubricators and Bettendorf metal tender trucks.

CAR BUILDING.

The American Car & Foundry Co. has miscellaneous orders for 12 cars.

The Canadian Pacific is reported to be asking prices on 500 box cars.

The Lake Shore & Michigan Southern has ordered two mail cars from the Pullman Co.

The New York Central & Hudson River has ordered two mail cars from the Pullman Co.

The Tennessee Central is rumored in the market for 700 coal cars of 100,000 lbs. capacity.

The New York, Susquehanna & Western has ordered 100 cars from the Standard Steel Car Co.

The Arizona & New Mexico has ordered one passenger coach from the American Car & Foundry Co.

The Maine Central has ordered 100 flat cars of 100,000 lbs. capacity from the Standard Steel Car Co.

The Seaboard Air Line has ordered two combination passenger coaches from the American Car & Foundry Co.

The Pennsylvania is asking bids on 200 coke cars, and has placed orders for 85 passenger coaches to be built at its Wilmington and Altoona shops.

The Pennsylvania has let a contract for 600 steel hopper coal cars. Half of these cars will be built by the Pressed Steel Car Co. and the remainder by the Cambria Steel Car Co.

The Swift Refrigerator Transportation Co., reported in our issue of September 23 as having ordered 200 refrigerator cars from the American Car & Foundry Co., has increased this order to 300 refrigerator cars.

The Mexican Central has ordered one combination third-class and one second-class coach from the Barney & Smith Car Co. The specifications for these cars are the same as those published in our issue of September 4, 1903.

The Erie has ordered 1,000 self-clearing hopper cars and 1,000 40 ft. twin hopper gondolas from the Standard Steel Car Co. An order has also been let to the American Car & Foundry Co. for 1,000 cars. These cars will all have a capacity of 100,000 lbs.

The Isthmian Canal Commission, Washington, D. C., has asked bids on 1,000 steel dump cars, and 500 American standard flat cars of 80,000 lbs. capacity to be used in the construction work on the Isthmus of Panama. Proposals to reach the office of the Commission not later than 12 o'clock noon, Oct. 20, 1904. Full particulars regarding the specifications for these cars are printed elsewhere in our news section.

The Montana R. R., as reported in our issue of September 23, has ordered two coaches from the Barney & Smith Car Co., for November 1 delivery. The cars will be 46 ft. long and 9 ft. 8 in. wide. The special equipment includes: Sterlingworth brake beams, Westinghouse air-brakes, Baker heating system, Barney & Smith seats and steel-tired wheels.

The Tonopah Mining Co., Tonopah, Nev., has ordered 20 gondola cars of 40,000 lbs. capacity from J. Hammond & Co., San Francisco, Cal., for October 15 delivery. These cars will weigh 22,000 lbs., and measure 28 ft. long, 7 ft. 4 in. wide and 4 ft. high. The special equipment includes: Westinghouse air-brakes, Kelso couplers, Harrison dust guards, and Pittsburg Spring & Steel Co.'s springs.

The Delaware & Hudson has ordered 100 composite steel coal cars of 80,000 lbs. capacity from the Standard Steel Car Co. These cars will weigh 35,800 lbs., and measure 34 ft. long, over end sills; 9 ft. 2 in. wide, over side plank, and 9 ft. 6⅜ in. high. The spe-

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cial equipment includes: Cambria Steel Co.'s axles, American Steel Foundries' and Standard Steel Car Co.'s holsters, Simplex brake beams, Diamond "S" brake shoes, Janney couplers, Dunham dumping device doors, Miner draft rigging, McCord journal boxes, Railway Steel-Spring Co.'s springs, arch-bar trucks and Delaware & Hudson Co.'s specification cast wheels.

The Delaware, Lackawanna & Western has ordered two composite buffet cars from Barney & Smith. These cars will weigh about 120,000 lbs., and measure 70 ft. long, 10 ft. wide, over sills; and 9 ft. 7½ in. high, inside at center. The special equipment includes: D., L. & W. bolsters, Streeter brake shoes, Westinghouse air-brakes and brake beams, Magnus metal brasses, Gould couplers, Forsyth curtain fixtures, Pantasote curtain material, Miner tandem draft rigging, Symington journal boxes and lids, Commercial acetylene gas light, Standard steel platforms, Empire roofs, Pittsburg Spring & Steel Co.'s springs, Barney & Smith six-wheel trucks, Pullman broad vestibules and Boies wheels.

BRIDGE BUILDING.

Alexandria, Man.—John Famden is receiving bids for building a steel bridge over the Assiniboine River north of Kennay, to consist of two central spans 110 ft. each, two wing spans 60 ft. each, one central concrete pier 30 ft. high, and three pile wing piers for main girders.

Appomattox, Va.—A bridge is proposed over the Appomattox River here, on which work will soon be begun.

Boston, Mass.—Bids are wanted October 12 by William Jackson, City Engineer, for the steel superstructure of the Atlantic avenue bridge. Bonds for $100,000 must be filled with the bid.

Bridgeport, Conn.—The New York, New Haven & Hartford is taking soundings to locate the site for a new 4-track drawbridge over the Housatonic River. The company will also build three or more others of the same type; one at Cos Cob, one over the Connecticut River, and the other over Shaw's Cove at New London.

Cincinnati, Ohio.—Bids are wanted October 29 by the Board of County Commissioners for building a bridge and abutments on the East Miami River road in Colerain Township.

Cleveland, Ohio.—Bids are wanted by A. O. Cunningham, St. Louis, Mo., October 15, for building a steel trunnion lift bridge with an opening of 120 ft., over the Cuyahoga River for the Wheeling & Lake Erie Railroad, to cost about $65,000.

Des Moines, Iowa.—The Board of Supervisors are considering the petition of residents of Crocker Township for a bridge over the Des Moines River to cost about $20,000.

Dinwiddie, Va.—Recent reports state that five county bridges have been carried away by high water.

Fall River, Mass.—A public hearing will be given in the Council chambers of Fall River, Mass., October 18, to consider the question whether the proposed drawbridge over Taunton Great River between Fall River and Somerset will interfere with navigation on the river. J. H. Willard, Lt. Col. Engrs., Newport, R. I., is in charge.

Harrisburg, Pa.—Bids are wanted October 18 by the State Board of Public Grounds & Buildings for the following steel bridges: Over Conewago Creek at York Haven; over Catawissa Creek at Birch's, Columbia County; over Connoquenessing Creek near Evans City, Butler County, and over Muncy Creek at Picture Rocks, Lyconing County.

Houston, Tex.—A resolution has been offered in the City Council to authorize an appropriation of $15,000 for the proposed bridge to connect Young and Laura streets, joining the fourth and sixth wards, and that bids be asked by October 10 for its construction.

Indianapolis, Ind.—A contract is reported let to Fife & Son at their bid of $138,712 for building the Morris street bridge over White River, to consist of five spans with a total length of 450 ft.

The Board of County Commissioners, reports say, has given contracts for 19 small bridges, seven of which will be built by the National Bridge Co. and five by the American Construction Co.

Kingsville, Tex.—The St. Louis, Brownsville & Mexico Railroad Co.'s new steel bridge over the Arroyo, Colo., has been carried away by high water.

Lawton, Okla. T.—The Secretary of the Interior, reports say, has given a contract for 25 steel bridges, as follows: To the Virginia Bridge & Iron Co. for 15 bridges in Comanche County and two in Caddo County; to the Springfield Bridge & Iron Co. for six bridges in Comanche County and two in Caddo County.

Marietta, Ohio.—The Marietta, Columbus & Cleveland Railroad will rebuild a four-span Howe truss bridge over the Little Hocking River. Total length, 504 ft. For plans and specifications address D. I. Roberts, President, Marietta, Ohio.

Milwaukee, Wis.—The Milwaukee Electric Railway & Light Co. will be asked to pay a share of the cost of the new bridge at Main street and repairing the one at Sixth street. The total cost of the improvements will be about $80,000.

Morrissey, B. C.—The Deputy Commissioner of Lands and Works, Victoria, is asking bids for a steel bridge over the Elk River at this place. Plans at the office of the Government Agent, Kamloops, B. C.

Mt. Clemens, Mich.—The Detroit United Railway, reports say, has offered to pay $7,500 towards building an iron bridge 70 ft. wide over the Clinton River. The total cost of the bridge will be about $20,000.

Nebraska City, Neb.—The County Commissioners, reports say, have decided to build three steel bridges, one near Talmage, one near Douglas and the other near Berlin, in Otoe County.

Newark, N. J.—Bids are wanted October 18 by Essex Park Commission for building the concrete masonry bridge abutments, wing walls and piers at Weequahic reservation, Newark. Bids are also wanted for building a steel girder bridge over the tracks of the Lehigh Valley at the same place, to consist of three spans 160 ft. 11 in. between abutments, with 20-ft. roadway and 8-ft. sidewalk. A. Church is Secretary.

Ortiz, Mex.—The large iron bridge of the Mexican Central over the San Pedro River, as recently reported in these columns, has been damaged to the extent of about $150,000. Three piers and one abutment are standing, which will be a saving of $60,000 in the cost of rebuilding.

Pittsfield, Mass.—Plans are ready for building a new bridge over the Housatonic River at New West street at a cost of about $7,500, to be built jointly by the city and the Pittsfield Street Railway Co.

Racine, Wis.—The Modern Steel Structural Company, of Waukesha, was the lowest bidder for rebuilding the Sixth street bridge, their bid being for $14,762. The Worden-Allen Co., of Milwaukee, bid $15,685, and the Wisconsin Bridge & Iron Co., of Milwaukee, $15,840.

Riverside, Cal.—Bids are wanted October 5 by the Board of Supervisors for building the foundations of a bridge over the San Jacinto River.

Saginaw, Mich.—A committee has been appointed by residents to secure the building of a free bridge over the Tittabawassee River at State street, to cost between $10,000 and $15,000.

Syracuse, N. Y.—The Rochester, Syracuse & Eastern Railroad Co., reports say, has plans ready for building a bridge with concrete abutments and steel arches 1,400 ft. long over the Montezuma swamps, to cost about $125,000; also to build a similar bridge 700 ft. long in Brighton.

Toledo, Ohio.—The Lake Shore will at once build a new bridge over its tracks at Fassett street.

Toronto, Ont.—The City Engineer has been asked to report on the cost of a new steel bridge from Hanlan's Point to Turner's Baths.

York, Pa.—The Northern Central is planning to build a steel bridge over Codorus Creek.

Other Structures.

Brooklyn, N. Y.—The Pennsylvania, reports say, has bought an additional large plot of ground between Sixty-third and Sixty-fifth streets and between Second avenue and the water front, at Bay Ridge, Brooklyn, N. Y., adjoining the block already in possession of the company, which is to be used as a site for its large freight terminal.

Decatur, Ind.—The Toledo, St. Louis & Western, reports say, is planning to build large repair shops here.

Fairmount, W. Va.—The Baltimore & Ohio, reports say, is planning to spend about $1,000,000 for improvements at this place, which is the junction of three divisions. A large amount will be spent in building new freight yards and increasing its car and locomotive repair shops.

Galeton, Pa.—The Buffalo & Susquehanna Railroad Co., reports say, has given a contract to the McClintic-Marshall Construction Co. for building its new machine and boiler shop at Galeton, Pa. The main building is to be 65 ft. wide and 175 ft. long.

Harriman, Tenn.—The Tennessee Central, reports say, is making surveys here to locate the site for new yards and repair shops.

Los Angeles, Cal.—The Southern Pacific, reports say, has decided to remove the Arcade and build a new $250,000 passenger station on its site, for which plans have been completed and are awaiting approval. The River station is also to be torn down and a $50,000 three-story structure built on this site. The company will also build at San Bernardino a station to cost $20,000.

Louisville, Ky.—The Southern Indiana Traction Co., reports say, has completed arrangements for beginning work at once on its new brick and stone station at Market and Jefferson streets, to be three stories high. Plans are now being made by D. X. Murphy & Bros.

Mexico, Mo.—The union passenger station of the Chicago & Alton and the Wabash at this place was destroyed by fire September 24. The Chicago & Alton has already bought ground as a site for a new station, on which work will be commenced shortly.

Moncton, N. B.—Separate bids are wanted October 10 by D. Pottinger, General Manager of the Intercolonial Railway Co., for building new stations and freight sheds at Mitchell, P. Q., and at Aulac, N. B. Separate bids are also wanted October 12 at the same address for building brick and stone passenger stations at Pictou, N. S., and at Antigonish, N. S.

Newark, N. J.—The Central of New Jersey, reports say, has bought a large plot of ground as a site for a six or seven-story fireproof warehouse.

New Brunswick, N. J.—The new passenger station of the Pennsylvania, recently completed at a cost of about $100,000, was formally opened September 28.

Newton, Kan.—The Atchison, Topeka & Santa Fe has given a contract to McLeod & Nelson, of Chicago, for building a six stall addition to its roundhouse 90 ft. deep, to cost $15,000; also for building a new brick tank shop 64 ft. x 100 ft., to cost $10,000.

Pittsburg, Pa.—The Wabash, reports say, has given a contract to the Carnegie Steel Company for about 4,000 tons of steel to be used in its new freight house, which

is to be 150 ft. wide and 800 ft. long, two stories high, between Fourth and Sixth avenues. It will contain eight elevators for the distribution of freight, and will cost $200,000.

Woodbury, N. J.—The West Jersey & Seashore Railroad, reports say, will build a new passenger station at the foot of Hopkins street.

Youngstown, Ohio.—The Baltimore & Ohio, according to reports, is receiving bids for building its new passenger and freight station here.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Adrian & Jackson Traction.—Articles of incorporation have been filed by this company in the State of Michigan with an authorized capital of $320,000. The company proposes to build an electric railroad from Adrian to Jackson, with a branch to Cement City. The total length of the line will be about 40 miles. J. E. Bugbee, F. B. Smart, W. H. Hand and others, of Adrian, Mich., are incorporators.

Bayfield, Lake Shore & Western.—Rights of way have been secured for this road from Bayfield, Wis., to Cornucopia, 15 miles, and grading is to be begun on this section of the line at once. It is the intention of the company to eventually build to Superior, 65 miles from Bayfield. Work on the remaining portion of the line will not be begun until the section to Cornucopia has been completed. F. J. Stevenson, Cornucopia, Minn., may be addressed. (July 29, p. 47.)

Buffalo, Batavia & Rochester (Electric).—Incorporation has been granted this company in New York with an authorized capital of $3,500,000 to build an electric railroad from Williamsville, Erie County, N. Y., to Rochester, 65 miles, with a branch line to Akron. W. N. Evarts, E. E. Lewis, Jr., G. E. Pierce and others, of Buffalo, are incorporators. The principal office will be at Buffalo.

Cumberland R. R.—Press reports state that this road, which is promoted in the interest of the Southern, is under construction between Laurel Fork, Tenn., and the head of the Clear Fork River, about 14 miles. S. P. Condon & Co., Knoxville, Tenn., are the contractors. Henry Fonde is President.

Denver & Rio Grande.—Press reports state that surveys have been completed for a branch line from Sargents, Colo., to White Pine, 11 miles. This line will reach some iron ore deposits which have recently been acquired by the Colorado Fuel & Iron Co. E. J. Yard, Denver, Colo., is Chief Engineer.

Denver, Enid & Gulf.—According to newspaper reports, grading has been begun on the proposed extension from Enid, Okla. T., northwest to Kiowa, Kan., 100 miles. The company will endeavor to have this line completed before next summer. (September 16, p. 94.)

Denver, Northwestern & Pacific.—The contract for grading this line between Arrowhead, Colo., and Hot Sulphur Springs, 25 miles, has been let to Orman & Crook, Pueblo, Colo. The contract is said to involve an expenditure of about $500,000. H. A. Sumner, Denver, Colo., is Chief Engineer. (September 30, p. 110.)

Great Northern.—Press reports state that this company has let a contract to A. L. Riley, St. Cloud, Wis., for building a 49-mile extension in North Dakota. The company has also let a contract to A. Guthrie & Co. for an extension out of Mohall, N. Dak., in a northwesterly direction for 15 miles.

Gulf & Ship Island.—This company has completed its Silver Creek branch from Pinola, Miss., south to Silver Creek, 21 miles. (See Construction Supplement.)

Gulf, Hutchinson & Northwestern.—Press reports state that contracts for grading this proposed line between Oberlin and Jennings, Kan., will be let within the next 30 days. Rights of way have been nearly all secured and surveys for the line have been finished. The proposed route is from Atwood, Rawlins County, Kan., through Oberlin, Jennings, Lenora and Webster to Stockton, 100 miles. Eugene Tilleux, Hutchinson, Kan., is President. (September 16, p. 95.)

Illinois & Wisconsin.—This company has been incorporated in Illinois to build a railroad from Chicago northwest to Barrington, 30 miles. R. E. Burke, C. E. Crafts, A. L. Shiffman and others, of Chicago, are interested.

Intercity Link Railroad.—Two charters have been obtained by this company, one in New Jersey and the other in Pennsylvania, authorizing the construction of a tunnel under the Delaware River between Philadelphia and Camden, N. J. The authorized capital stock is $125,000. Clarence Wolf, Albert Wolf, W. D. Slanger and others are named as incorporators.

Irvington Railroad.—This company has been incorporated in New Jersey to build a railroad two miles long from Elizabeth to Irvington. T. E. Swain, Camden, N. J., is one of the incorporators.

New Berlin & Winfield.—A charter has been granted this company in Pennsylvania to build a narrow gage railroad between Winfield, Pa., and New Berlin, seven miles. I. C. Burd, Shamokin, Pa., is President.

New York, New England & Hartford.—Owing to the acquisition of the Central New England and the expected increase in traffic over the Poughkeepsie Bridge route, this company is reported to be planning to double track certain portions of its line from Poughkeepsie to New Haven. The company will then be able to handle the eastbound freight traffic with much more facility than over the heavy grades of the C. N. E. and of the Highland and Midland divisions of the N. H.

Norfolk & Western.—The report of this company for the fiscal year states that the following work has been completed since June 30, 1903: Tug Fork branch from Welch, Va., to a point near Gary, eight miles; spur line from Iaeger to Ritter, 4.9 miles; extension of Chestnut Creek branch from Blair to Galax, three miles; extension of Widemouth branch 12.8 miles to the east approach of Clarks Gap, and the completion of 10 miles on the new low-grade line between Naugatuck and Kenova, 59 miles.

Philadelphia, Baltimore & Washington.—Work has been resumed on the improvements in Wilmington, Del. Six months ago, when the work was less than half completed, the contractors, Ryan & Kelly, were told to suspend operations, in accordance with the policy of the road to reduce operating expenses.

Placerville & Lake Tahoe.—Grading has been completed on this road from Placerville, Cal., to Camino, eight miles. Track laying is in progress, and this part of the line will be opened for traffic before the end of the year. The road is projected to run eventually from Placerville to Tallac, 65 miles. W. J. Barnett, Placerville, is interested. (April 22, p. 314.)

San Francisco & Napa.—It is reported that bids will be received until October 13 by N. W. Collins, Clerk of Napa County, Cal., for a franchise to build and operate a steam railroad from San Francisco to Napa, 50 miles. H. B. Goodman, Napa, Cal., is interested. (May 13, p. 376.)

Southern Indiana.—See Railroad Corporation News.

Southern Pacific.—Track laying is reported completed on the branch line from Raceland, La., to Lockport, eight miles. The road will be opened for traffic early in October. Surveys have also been completed for extensions from Lockport southeast to Cutoff, 12 miles, and from Arnaudville north to Port Barre, 12 miles. S. W. Stubbs, New Orleans, La., is the engineer in charge.

Vincennes, Washington & Eastern (Electric).—This company has been incorporated in Indiana to build an electric railroad from Washington west to Vincennes, 20 miles. The authorized capital is $1,000,000. A. F. Caleb, F. E. Hakeman, H. T. Trueblood and others, of Washington, Ind., are incorporators.

Whitehall R. R.—Incorporation has been granted this company in Illinois to build from Whitehall northeast to Coal City, 150 miles. The principal office of the company will be at Whitehall. J. P. Ground, Winchester, Ill.; J. R. Davis, Jacksonville, Ill.; H. C. Morow, Whitehall, Ill., and others are incorporators.

Wyandotte Terminal.—Incorporation has been granted this company in Michigan with a capital stock of $100,000 for building a terminal railroad connecting the Detroit Southern and the property of the Michigan Alkali Works with the Michigan Central and the Detroit River near Wyandotte. M. R. Bacon, P. R. Will, J. J. Griffith and E. P. Smith, of Wyandotte, Mich., are incorporators.

RAILROAD CORPORATION NEWS.

Canada Atlantic.—See Grand Trunk below.

Canadian Pacific.—At the annual meeting of this company on October 5, the stockholders authorized an increase of $25,000,000 in the capital stock. Of this amount, $10,000,000 will be offered to the stockholders at par, subscriptions being made to 5 per cent. of present holdings. The proceeds from the sale of this stock will be used for building the new line from Sudbury to Toronto, and for extensions on the Prairie division. By a vote of the stockholders, the directors were authorized to arrange for the construction of two additional steamships with a speed of 18 knots.

Central of Georgia.—The operations of this company for the fiscal year ending June 30 show gross earnings of $9,396,931, an increase of $232,461. Operating expenses increased only $41,777, leaving a gain in net earnings of $190,684. Passenger earnings were $2,164,658, an increase of $160,654; freight earnings decreased $74,764, and earnings from miscellaneous sources increased $159,049. Charges for conducting transportation were $228,215 higher than in 1903, but there were decreases of $34,251 and $157,624 in the maintenance of way and maintenance of equipment accounts. Gross earnings per mile increased from $4,968, to $5,029. Operating expenses per mile amounted to $3,681, as against $3,698 in 1903. There was acquired during the fiscal year a line from Lyerly to Toles Hollow, Ala., 9½ miles. The Chattahoochee & Gulf Railroad was extended from Sellersville, Ala., to Lockhart, 24 miles, and about 100 miles of track on the Columbus division was entirely reconstructed. Eighty-eight new side and spur tracks were built, aggregating 33 miles, and extensive additions were made in the yards of the company at Savannah, Macon, Chattanooga and Albany. During the year, five passenger, seven switching and 18 freight locomotives were purchased, and 200 box cars and 800 coal cars were added to the equipment. The company also bought nine passenger coaches and nine express and baggage cars. After deducting all fixed charges and interest, the net income for the year was $338,467, as against $203,506 last year, an increase of $134,960.

Chicago & Alton.—Kuhn, Loeb & Co., bankers, New York, announce by circular that the preferred stock deposited with them under the agreement of December 23, 1903, has been sold for cash with the approval of the committee, and the firm will distribute the proceeds to the owners, $84 for each share of preferred stock. The committee consisted of J. A. Stewart, E. H. Harriman and J J. Mitchell.

Chicago, Indianapolis & Louisville.—The report of this company for the fiscal year ending June 30 shows gross earnings of $5,300,622, an increase of $234,491. Oper-

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ating expenses were $3,416,169, an increase of $299,812, leaving a decrease in net earnings of $65,321. The report states that the increase in operating expenses for labor charges alone amounted to $170,000, largely due to advanced rates of wages. The total surplus remaining after payment of dividends and fixed charges was $3,375,751, an increase of $658,445 over 1903. The equipment was increased during the year by the addition of four coaches, eight locomotives and 200 freight cars.

GRAND TRUNK.—At the recent annual meeting of this company, it was announced that, in acquiring the Canada Atlantic, the Grand Trunk would guarantee the principal and interest of that company's $16,000,000 new 4 per cent. 50-year gold bonds. Part of these bonds are reserved for future capital expenditures.

GULF & SHIP ISLAND.—The annual report for the year ending June 30, 1904, shows gross earnings of $1,829,815, an increase over last year of $124,768, or about 7 per cent. Operating expenses were $1,229,235, an increase of $149,617, leaving a decrease in net earnings of $24,849. During the year the funded debt of the company was increased from $4,607,000 to $4,835,000 by the issue of first refunding and terminal 5 per cent. mortgage bonds to cover additions and betterments amounting to $228,000 made in 1903 and 1904. The traffic statistics show good progress in the handling of freight. The number of revenue tons of freight carried one mile increased from 70,880,918 to 80,758,993. The average freight-train load increased from 207 tons to 242 tons, and the average car load increased from 15.9 tons to 16.9 tons. The report states that the new branch line running south from Mendenhall, Miss., will be completed within the next 12 months. The Silver Creek branch has already been opened and will enable the company to handle about 25 per cent. more cotton in the coming year than it has in the past.

HOCKING VALLEY.—The report of this company for the fiscal year ending June 30 shows gross earnings of $5,725,483, a decrease of $324,115. Operating expenses increased $14,095, leaving a decrease in net earnings of $338,610. Heavy losses in coal and freight earnings were responsible for the decrease in gross earnings. These were caused in large part by the strike of the pilots on the Great Lakes in the early part of the season. Passenger earnings increased slightly, as did also mail and express earnings. The charges in the maintenance of way and conducting transportation accounts decreased, but the charges in the maintenance of equipment account increased owing to large renewals to rolling stock. After payment of all fixed charges, the net income for the year was $1,404,793, a decrease of $399,295. The percentage of operating expenses to earnings increased from 63.45 to 67.29, largely due, as stated above, to the unavoidable weather conditions and the strike on the Lakes. This company has reported its earnings for August, which show an increase of $28,106.

NASHVILLE, CHATTANOOGA & ST. LOUIS.—The annual report of this company for the fiscal year ending June 30 shows gross earnings of $10,206,022, an increase of $599,000, as compared with 1903. Operating expenses were $7,581,030, an increase of $584,427, leaving a decrease in net earnings of $10,643. The increase in the percentage of expenses to earnings for the past two years has been due mainly to the expenditure of $1,127,068 in 1903 and $1,102,199 in 1904 for additions to property, and included in operating expenses. During the year 15 new locomotives were purchased and nine coaches and 500 freight cars were added to the equipment. After deducting all fixed charges, the total income for the year was $3,745,488, a decrease of $14,412.

NEW YORK, NEW HAVEN & HARTFORD.—This company has bought the Middletown Street Railroad, a company which owns 10 miles of track and has a capital stock of $125,000. It is said that the price paid for the stock was $15 per share, the par value being $25.

VERA CRUZ & PACIFIC.—Speyer & Co., bankers, New York, announce that the $6,000,000 bonds of this railroad have been purchased by them from the receiver of the Maryland Trust Co. and that practically the whole issue has been sold. The original bid made by Speyer & Co. of 88½ is said to have been raised to 91½, owing to the sharp conflict which developed between Speyer & Co., Kuhn, Loeb & Co., and Baring, Magoun & Co., all of New York. (September 30, p. 112.)

RIO GRANDE, SIERRA MADRE & PACIFIC.—This road, which runs from El Paso and Ciudad Juarez to Terrazas, Mexico, 250 miles, is reported sold to W. C. Greene and Frank Murphy, of El Paso, Tex. It is stated that the road will be extended to the Pacific coast, running through a large tract of timber land in the Sierra Madre Mountains, in the State of Chihuahua.

ST. LOUIS, BROWNSVILLE & MEXICO.—This company has amended its charter so as to increase its capital stock from $1,000,000 to $3,850,000. It is stated that the new stock will be used to pay for the proposed Galveston-Houston branch. The company now operates a line from Robstown, Tex., to Brownsville, 141 miles, and work is in progress on an extension to Bay City.

SEABOARD AIR LINE.—An injunction has been issued restraining this company from absorbing the Seaboard & Roanoke. The injunction is asked by C. Chauncey, who holds $11,000 worth of certificates of indebtedness of the latter company. The case has been set for hearing in Norfolk before the United States Court on November 11.

SOUTHERN INDIANA.—The report of the operations of this company for the fiscal year shows gross earnings of $1,293,581, as against $942,572 last year, an increase of $351,009. Operating expenses were $788,818, as against $460,546 last year, an increase of $278,272, leaving an increase in net earnings for the year of $73,727. The report states that work has been begun on the extension from Terre Haute to Chicago and that it is hoped to have this work completed by January, 1906. Contracts for grading from Terre Haute to the Illinois State line, about 27 miles, have been let and grading is in progress. This section involves a bridge across the Wabash River about five miles north of Terre Haute.

SOUTHERN PACIFIC.—The second instalment of the subscription to the new $40,000,000 Southern Pacific 7 per cent. non-cumulative preferred stock was paid on October 3. This makes the stock 50 per cent. paid in. The remaining payment of 50 per cent. is due on or before December 1, and the new preferred stock will be issued to the subscribers at that time. According to the offer made by the directors when the $100,000,000 preferred stock was issued, the shares subscribed for are redeemable at any time between July 1, 1905, and July 1, 1910, at 115, and may be converted into common stock at par at the option of the holder.

TERRE HAUTE & INDIANAPOLIS.—V. T. Malott, receiver, has made the statement that on October 31 the receivership of this road will be terminated, as the litigation has been settled and the company is now in good financial condition. The receivership was instituted in November, 1896.

WEST JERSEY & SEASHORE.—The stockholders of this company are offered at par $1,000,000 of common stock to be allotted to all holders of record October 7, on a basis of 25 per cent. of present holdings. The new issue will bring the total amount of stock outstanding up to $6,306,050. This leaves $1,769,995 which may still be issued at the discretion of the board. Part of the proceeds of the sale will be used in connection with the elevation of tracks in Camden and the revision of grades in Atlantic City.

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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

FRIDAY, OCTOBER 7, 1904.

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